ELECTRICAL REVIEW

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BROOK Ltd
HUDDERSFIELD • ENGLAND

You can standardise on motor starters

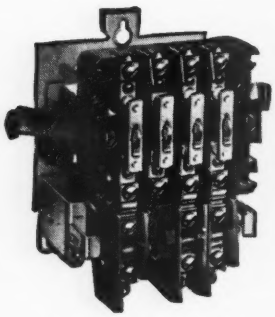
with MEM 'Autoline'

WHEN a new motor comes in you're never stuck for a starter if you keep a few MEM "AUTOLINES" in stock. The big advantage of the "AUTOLINE" is that it will provide overload precision protection for all motors rated between ¼ h.p. and 15 h.p.

The heaters are the only variable component involved and these can be selected from a range of 40 heaters to ensure precision protection for any motor up to 15 h.p. (25 amps. max.).

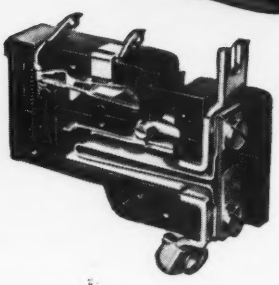
The MEM "AUTOLINE" is built to an advanced design produced by one of Britain's leading specialists in motor control gear. It has extra safety clearances and is substantially made in every detail.

Please send for Autoline Booklet No. 356(X).

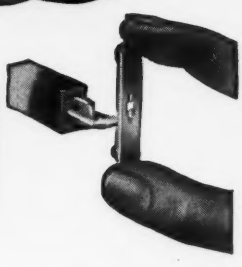


The Skeleton Pattern Units can be combined in various ways to meet a wide variety of different needs on machine tool applications.

Any MEM "AUTOLINE" starter can be changed from Automatic to Manual resetting operation in a few moments. A cover with "Reset" button only is available.



Exclusive new overload relay design with heaters specially designed for each rating means accurate protection under all conditions.

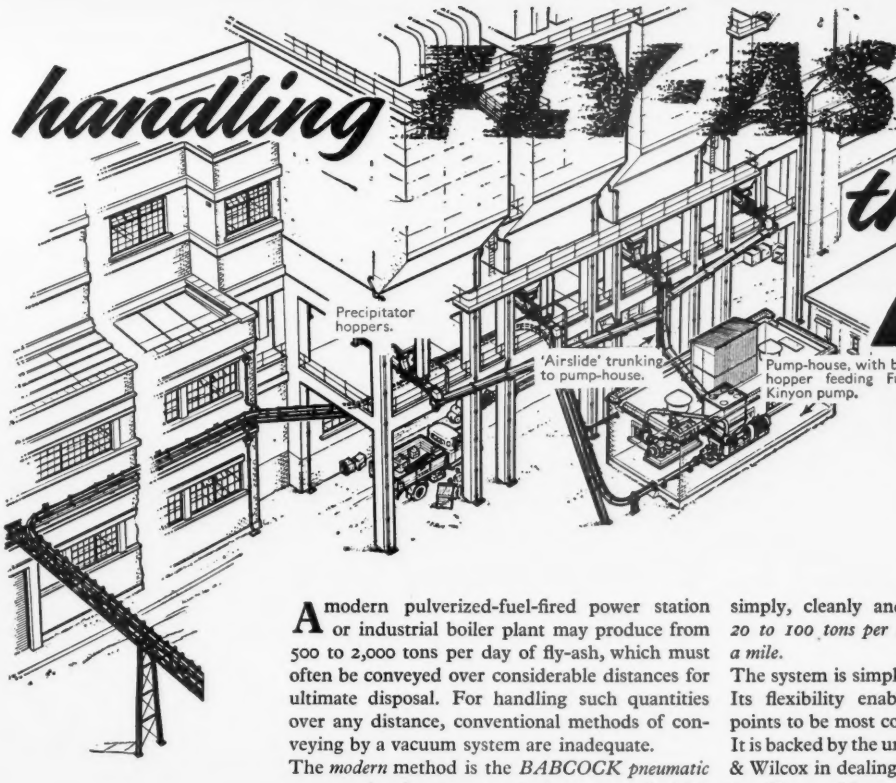


Contacts are of solid silver. Contact replacement is especially simple. Just flick over a spring catch and lift off.

MEM

MIDLAND ELECTRIC MANUFACTURING CO. LTD., TYSELEY, BIRMINGHAM, 11

handling FLY-ASH the EASY way!



A modern pulverized-fuel-fired power station or industrial boiler plant may produce from 500 to 2,000 tons per day of fly-ash, which must often be conveyed over considerable distances for ultimate disposal. For handling such quantities over any distance, conventional methods of conveying by a vacuum system are inadequate.

The *modern* method is the *BABCOCK pneumatic system* using *low-pressure* air, by means of which the *dry* dust is made literally to flow *under gravity*, through a patented form of diaphragm ducting.

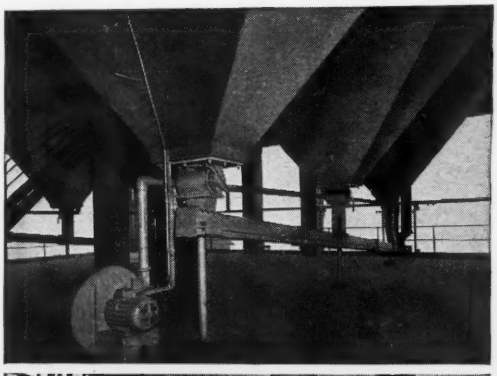
Fly-ash from any number of boilers is conveyed simply, cleanly and economically at rates from *20 to 100 tons per hour*, for distances up to *half a mile*.

The system is simple and trouble free.

Its flexibility enables collection and discharge points to be most conveniently situated.

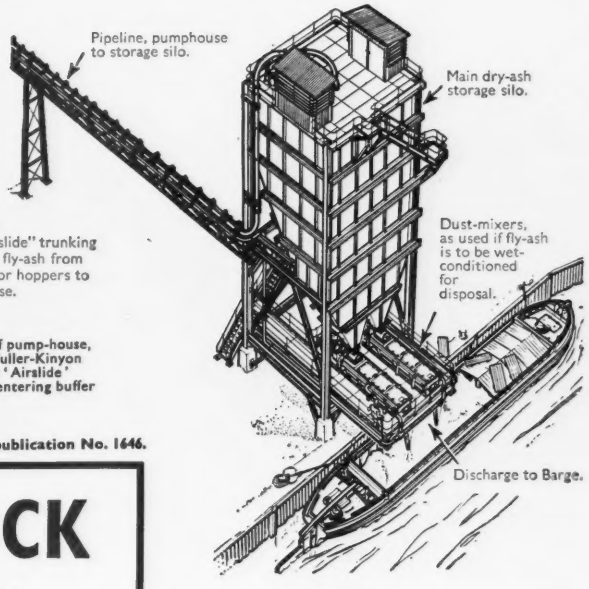
It is backed by the unrivalled experience of Babcock & Wilcox in dealing with large-scale ash and dust handling problems.

The Company designs and supplies *complete* installations, including the "Airslide" ducting, Fuller-Kinyon pumps and pipelines, for pumping the dry fly-ash from collecting hopper to silo or processing plant, all necessary bunkers, and disposal equipment.



Above left:
Main "Airslide" trunking conveying fly-ash from precipitator hoppers to pump-house.

Left:
Interior of pump-house, showing Fuller-Kinyon pump and 'Airslide' trunking entering buffer hopper.


Pipeline, pumphouse to storage silo.
Main dry-ash storage silo.
Dust-mixers, as used if fly-ash is to be wet-conditioned for disposal.
Discharge to Barge.

Ask for publication No. 1646.

BABCOCK

Low-Pressure

PNEUMATIC *FLY-ASH* HANDLING PLANT

BABCOCK & WILCOX LTD.
Materials Handling Division
BABCOCK HOUSE, 209 EUSTON ROAD, LONDON, N.W.1.

A

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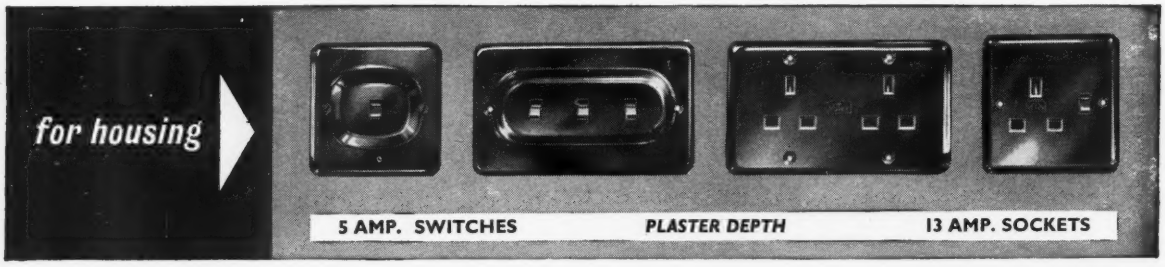

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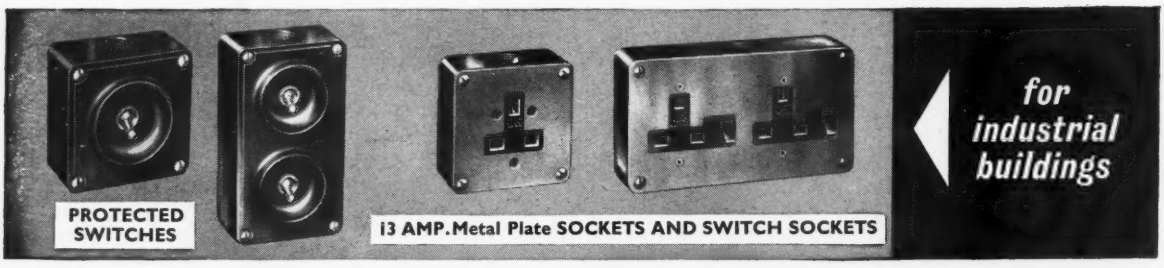
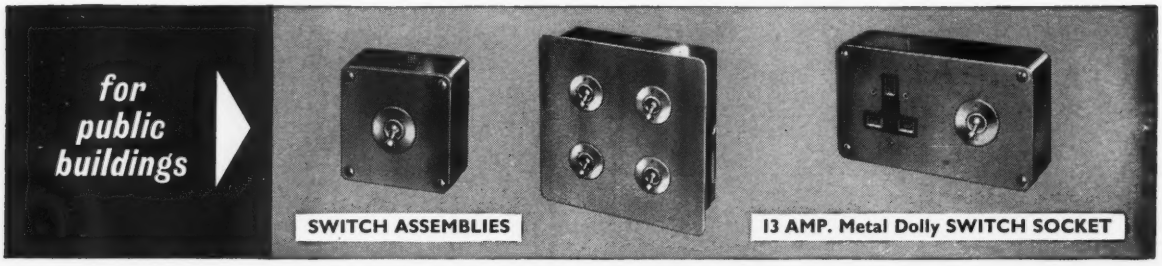
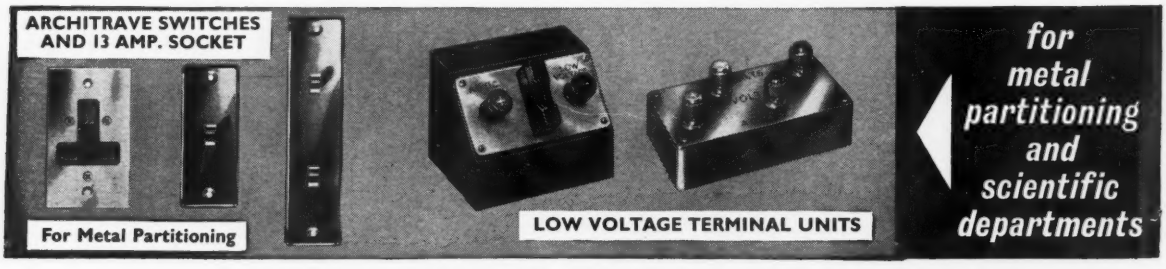


... specified by Architects and Consultants



... approved by Contractors everywhere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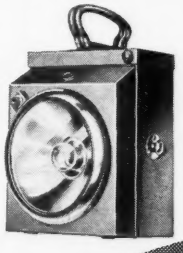

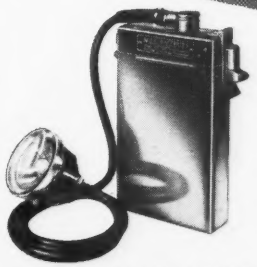

NIFE HEADLAMP NC113C

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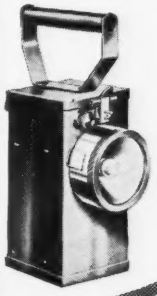

✻ **ILLUSTRATED LEAFLETS** about these and other Nife lamps will be gladly sent on request to: Nife Batteries, Redditch, Worcestershire.

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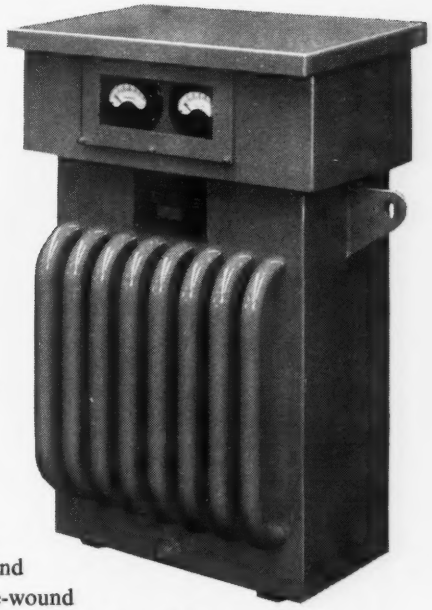

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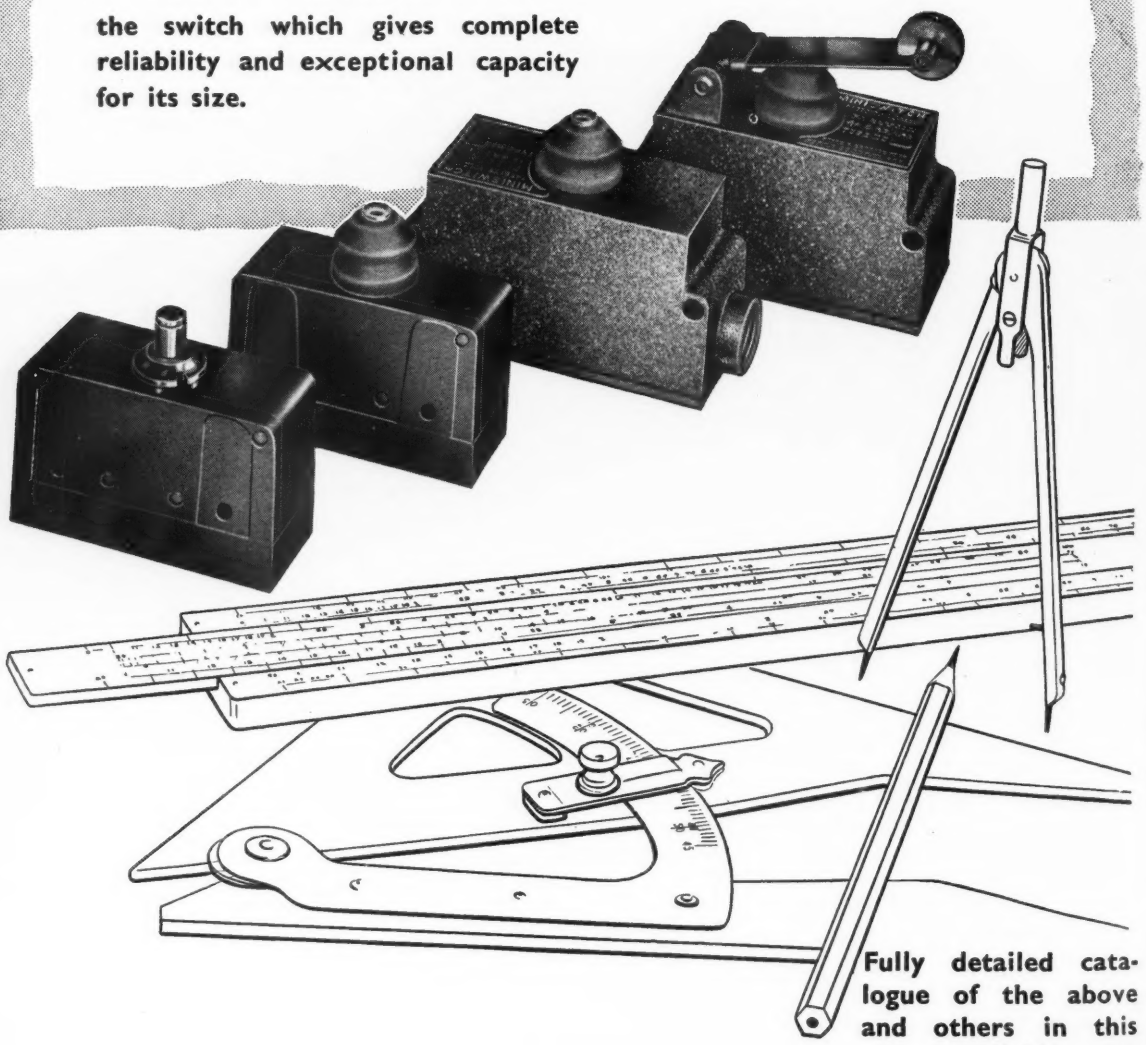

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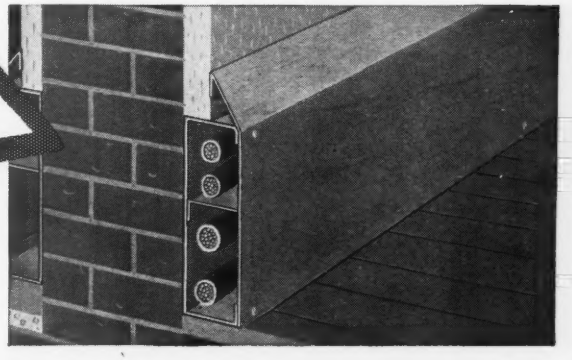

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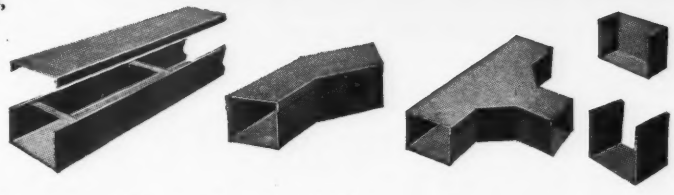

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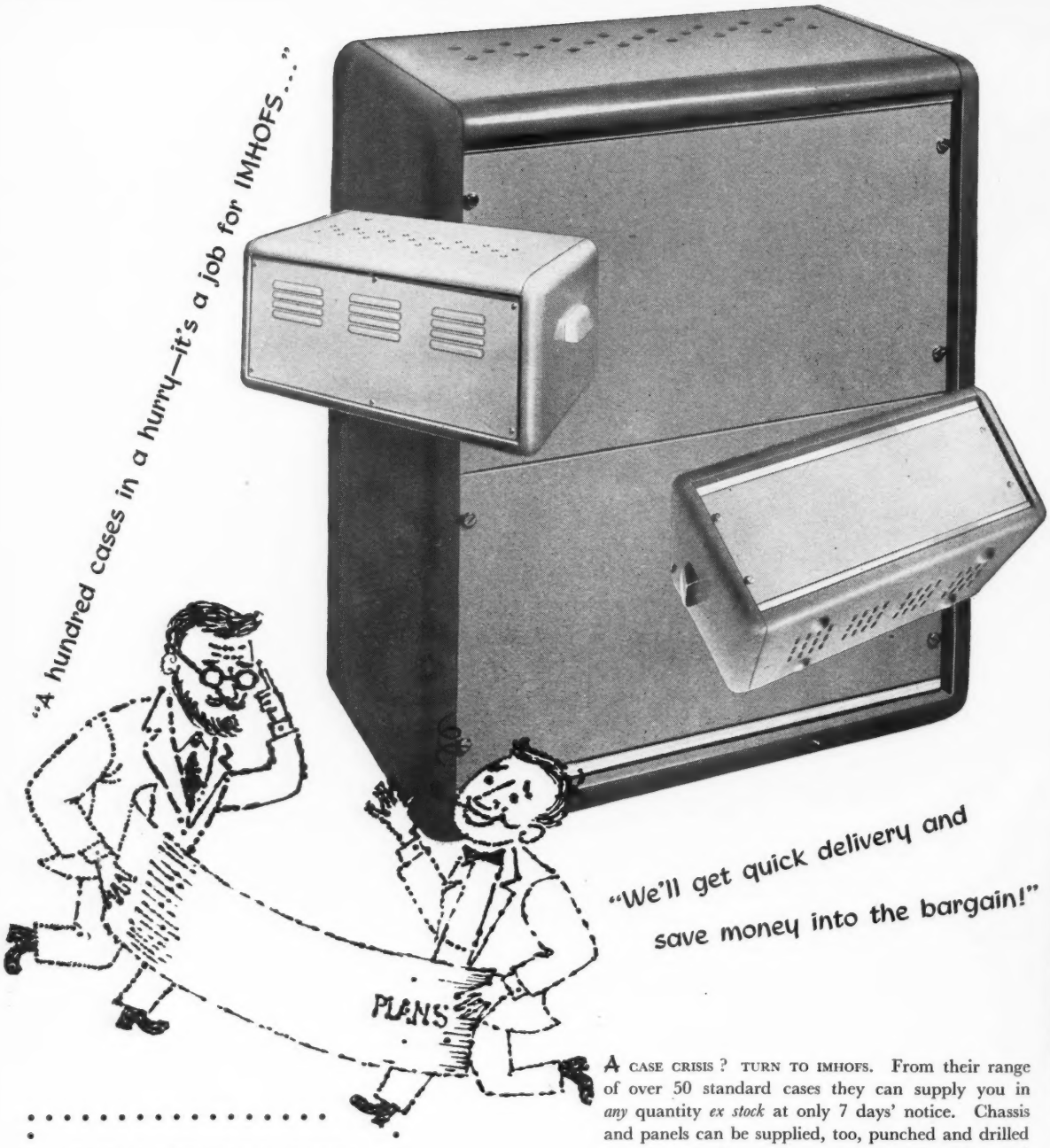

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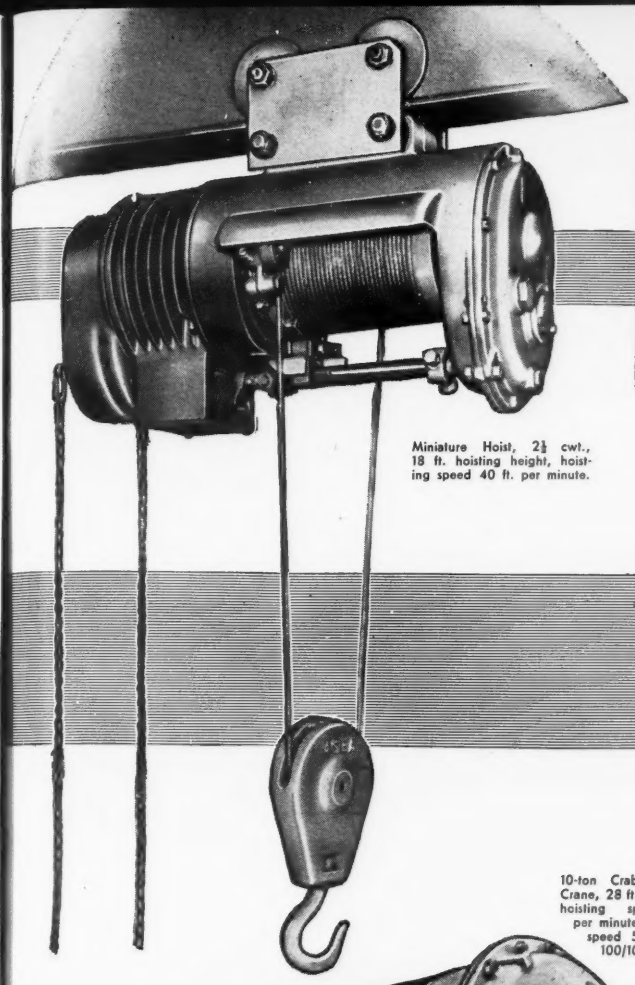
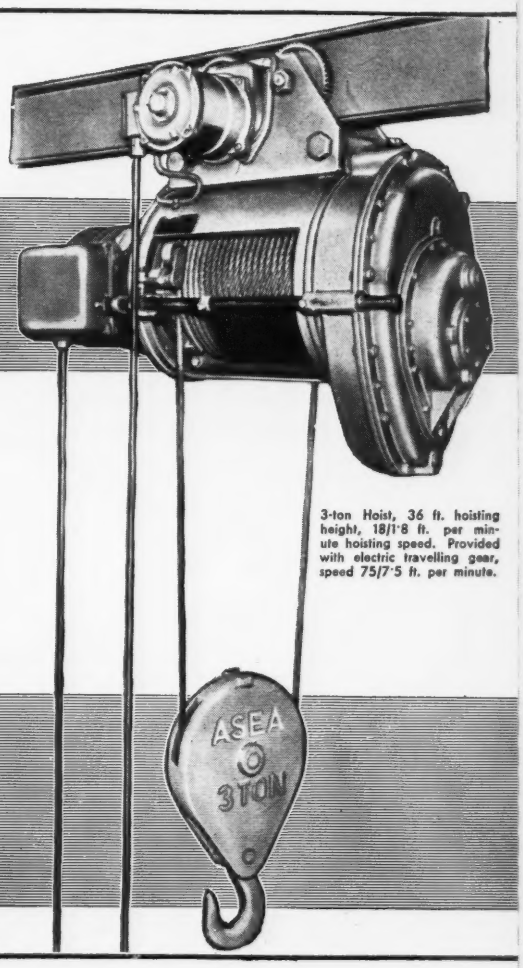


Miniature Hoist, 2½ cwt., 18 ft. hoisting height, hoisting speed 40 ft. per minute.



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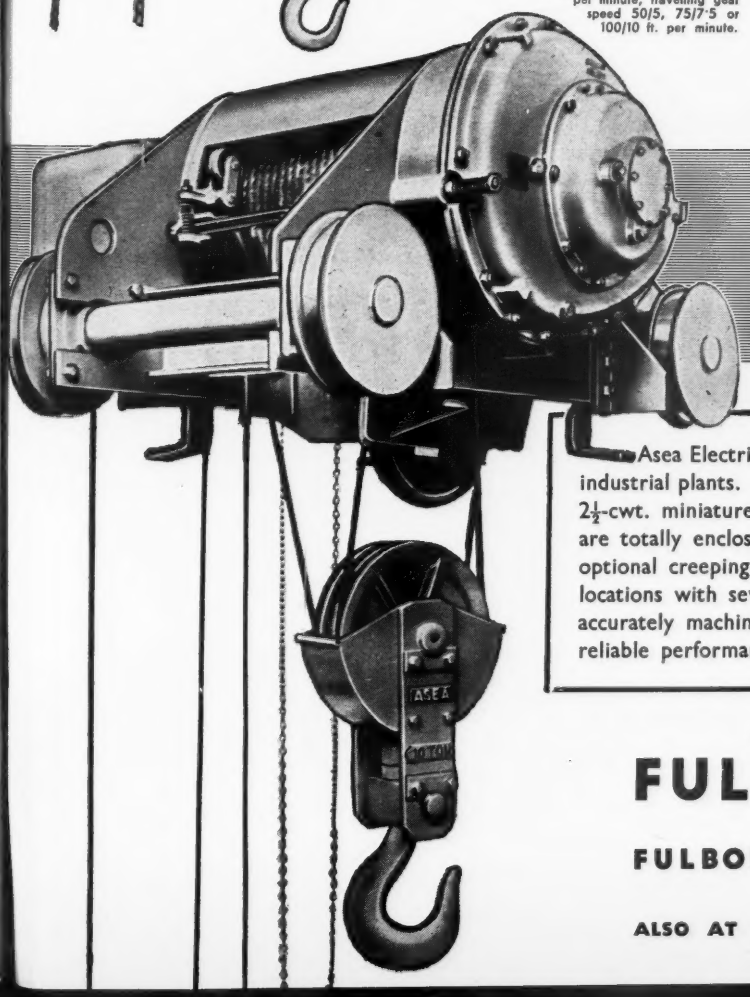

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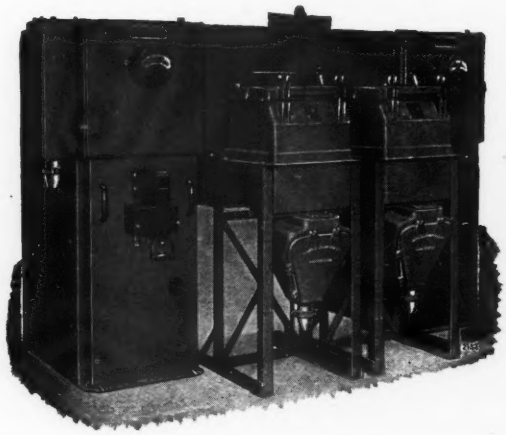

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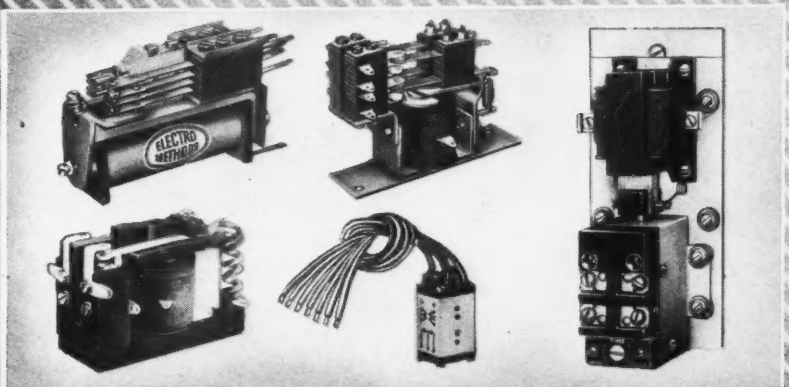

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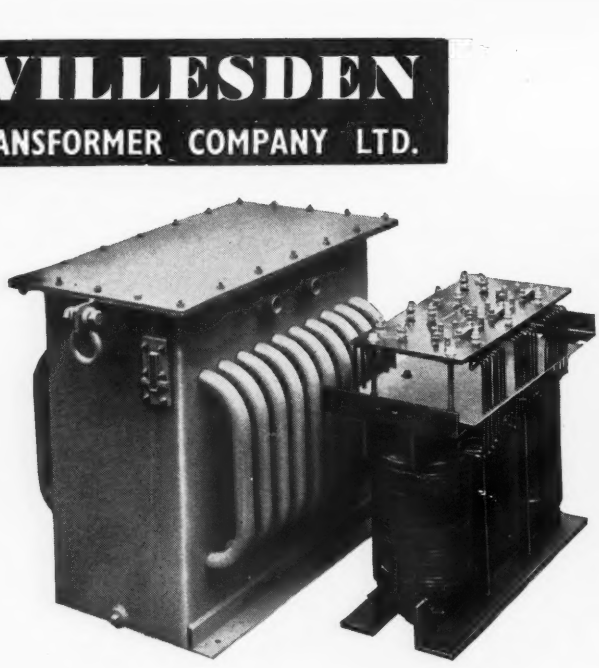

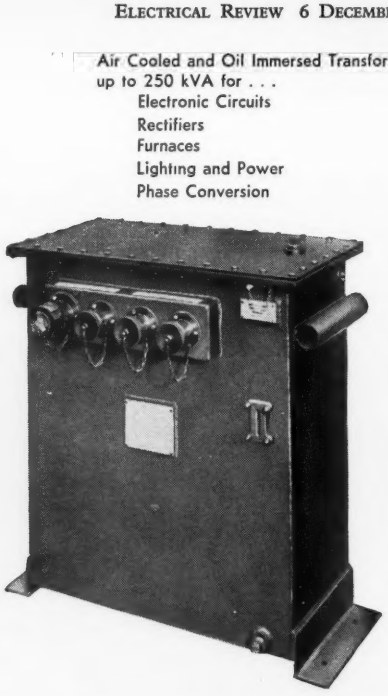

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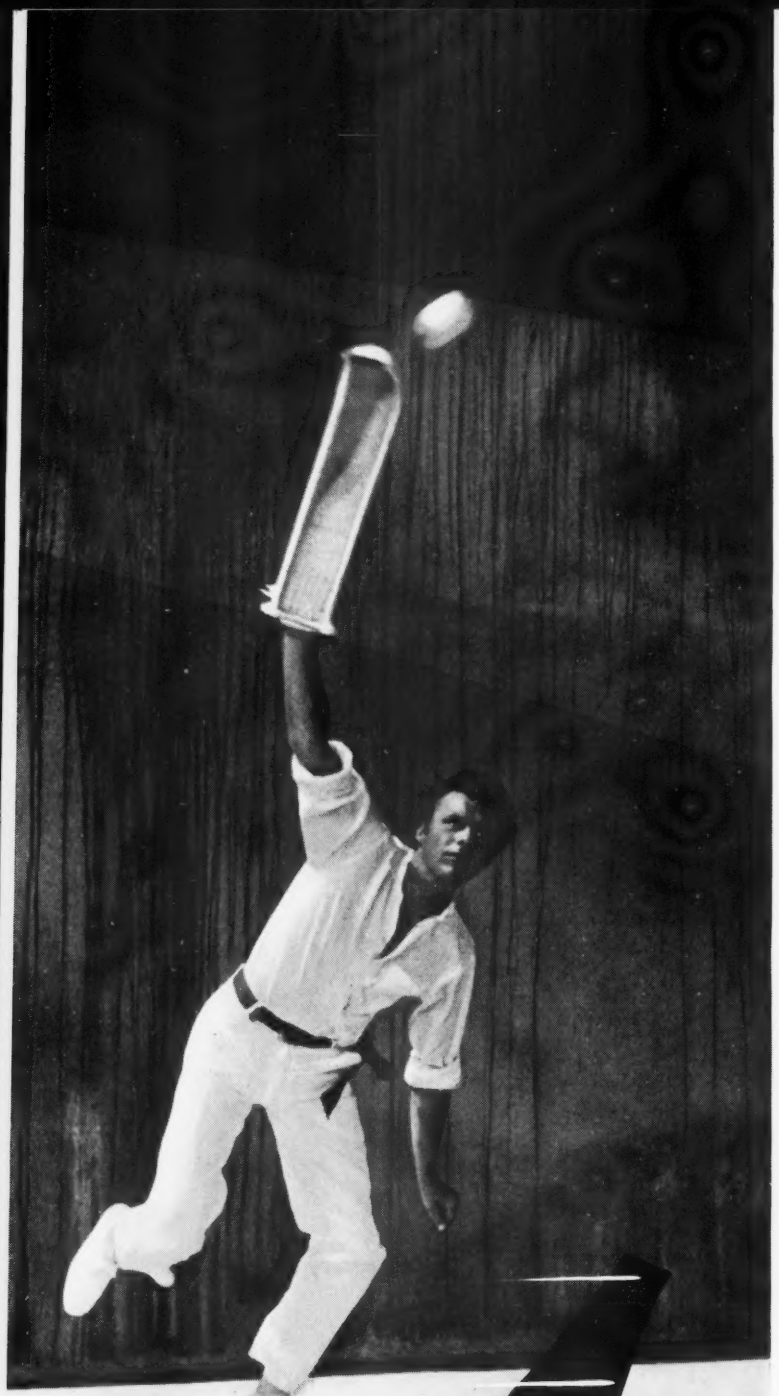

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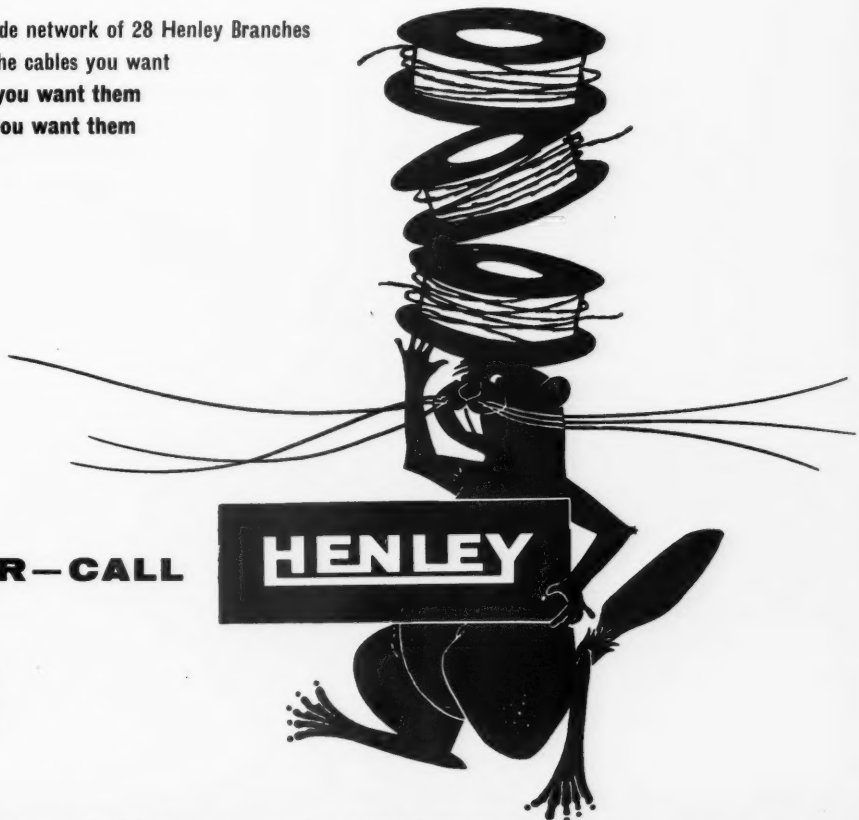

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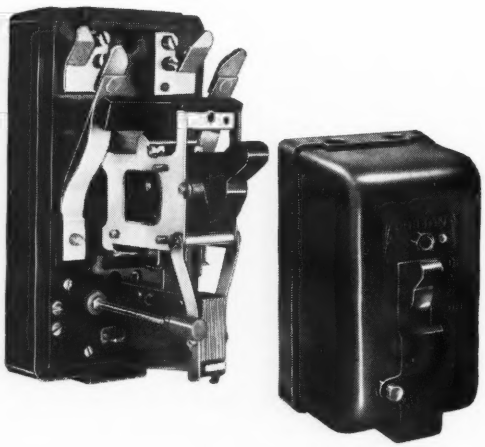
a 'down-to-earth' price for Chilton Earth Leakage Circuit Breakers 48/9



Chilton Earth Leakage Circuit Breakers

Type ELT/A (without overload protection). With its inherent simplicity of design this Earth Leakage Circuit Breaker fully complies with B.S.842 and provides complete protection against the possibility of shock. Suitable for all current ratings up to 60 amperes and with voltage ratings up to 500 volts A.C. A special unit for 100 ampere rating can be supplied to order. Chilton Earth Leakage Circuit Breakers are supplied in insulated moulded enclosures and the earth leakage tripping mechanism has been specially designed to ensure reliable operation even after long periods of inactivity in dirty, dusty, greasy or humid conditions. Units incorporating overload protection can be supplied to order.

New methods of manufacture enable CHILTON to offer their Earth Leakage Circuit Breakers at the substantially reduced price of 48/9d. per unit. As the foremost specialists in circuit protection, CHILTON have built into these units many years of accumulated experience. Consequently the reliability and efficiency of their Earth Leakage Circuit Breakers are second to none.

A NEW DEVELOPMENT

For the protection of personnel operating portable power tools and plant, there is now a range of CHILTON Monitoring Units. Designed for general industrial installation, these units can be supplied with or without Voltage-Operated Earth Leakage protection or Differential Current protection or a combination of both.

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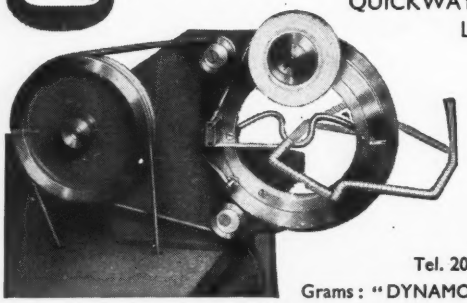

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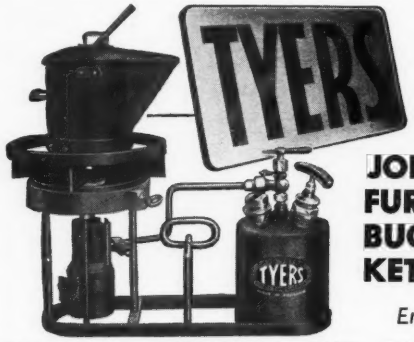

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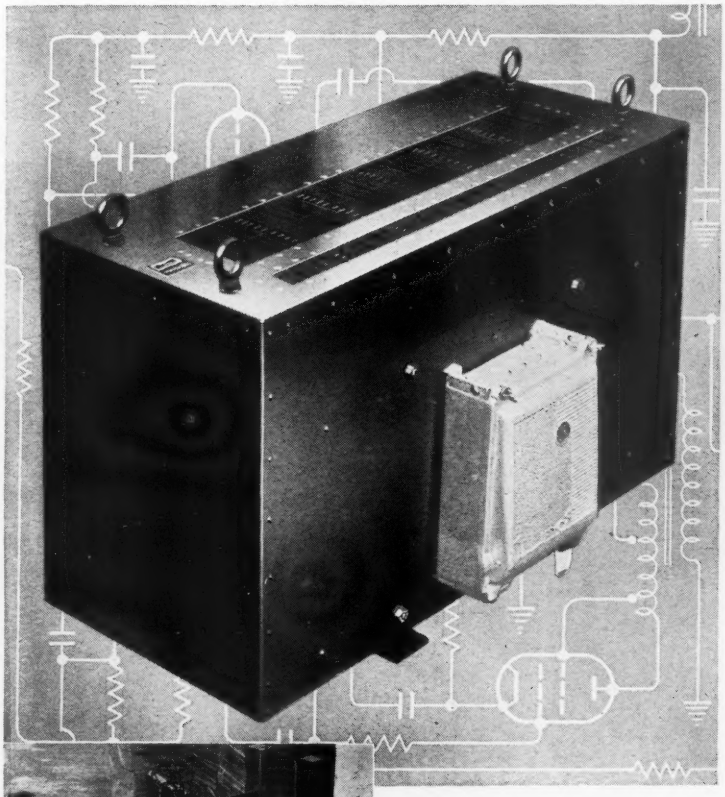

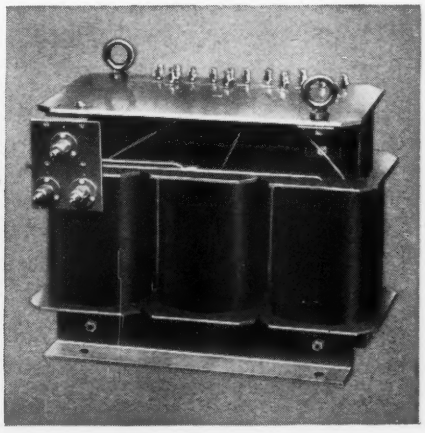

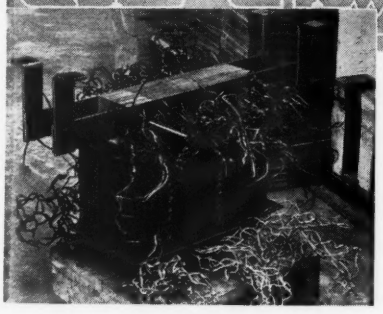

On the left (with an internal view shown beneath) is a three-phase power transformer with six channels per phase. Each channel has tappings to enable any voltage up to 180 to be selected in 5-volt steps. Maximum loading per channel—5 amps.
And above, less complicated but equally well made, is a three-phase H.T. transformer, delta-connected primary, star-connected secondary. Secondary 4300 v. 6 kVA. rating.
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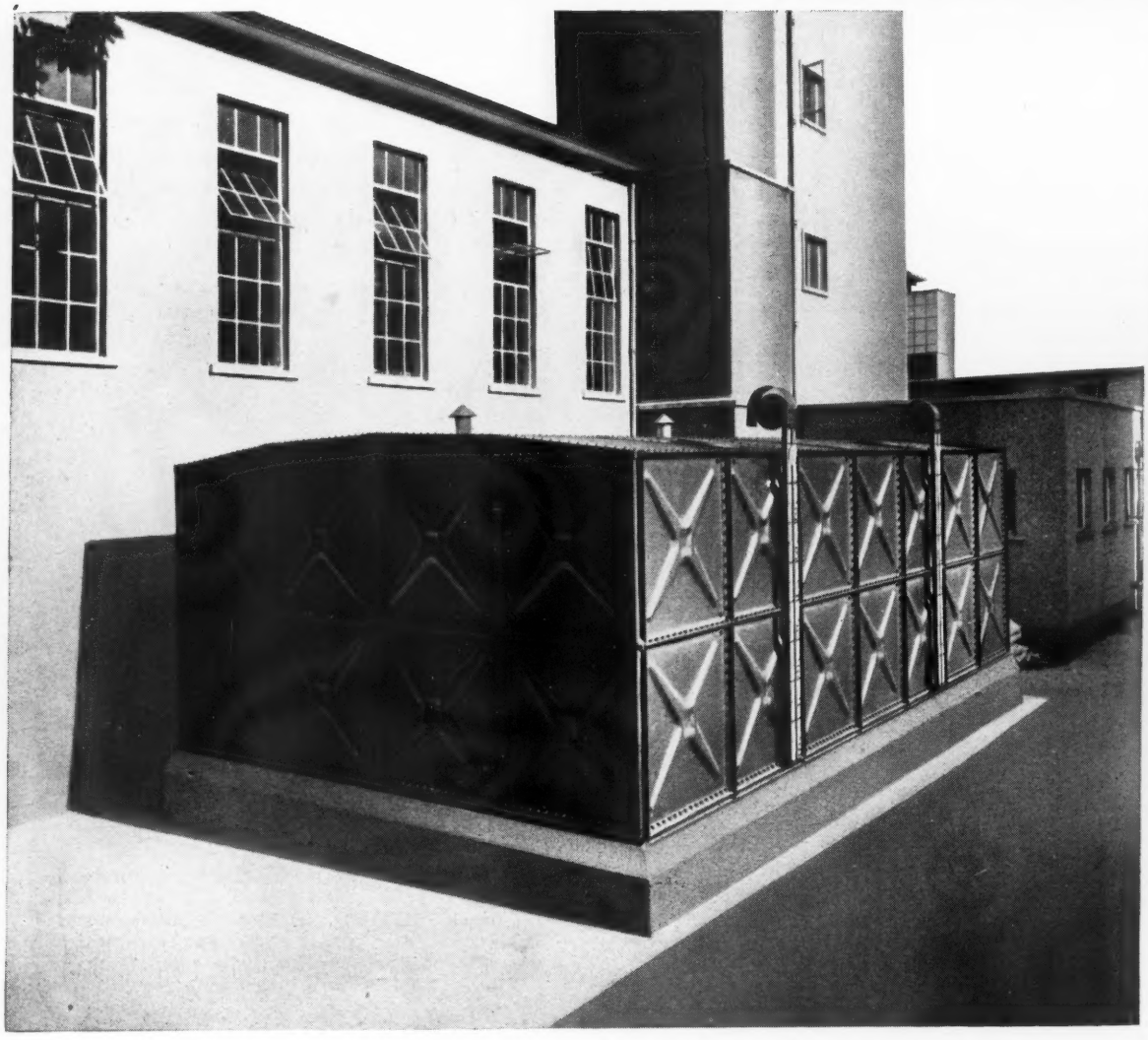

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Uses of 'Terylene' for electrical insulation

Braided cord or twine	For reinforcement of end windings
Tape	For insulation in varnished or unvarnished forms in motors and power cables
Varnished sheet	For slot insulation for armatures, rotors and stators
Lapped conductors	For fine and coarse lapped wires and strip
Braided flex	For domestic appliances
'Terylene' is officially specified by the G.P.O. for covering telephone cords.	

'TERYLENE' Polyester ICI Fibre

To find out more about 'Terylene' for insulation, consult your supplier, or write to the address below.

'Terylene' is the trademark for the polyester fibre made by
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The 'ELECO SLIM'

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We should like you to have the opportunity of examining the 'ELECOSLIM' features. May we send you a detailed leaflet, or perhaps a call from our representative would prove more helpful.

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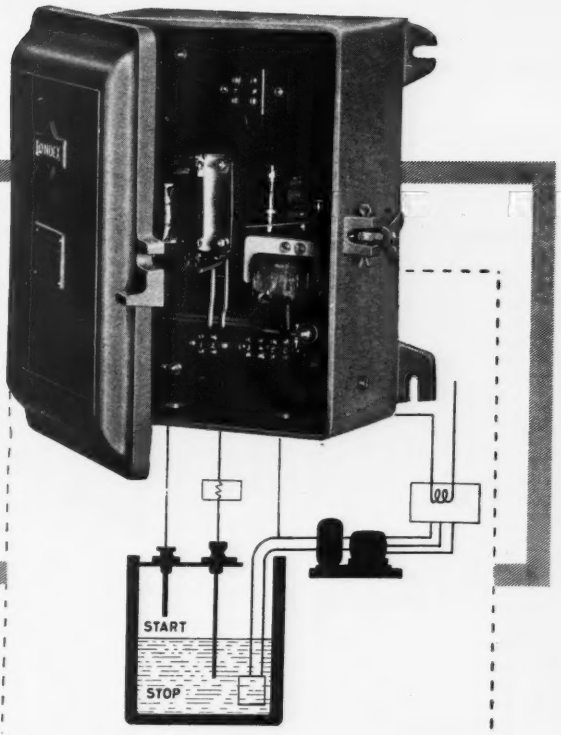

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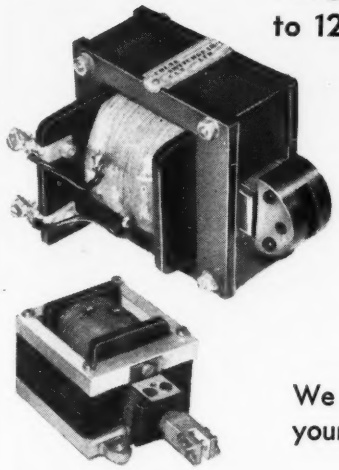

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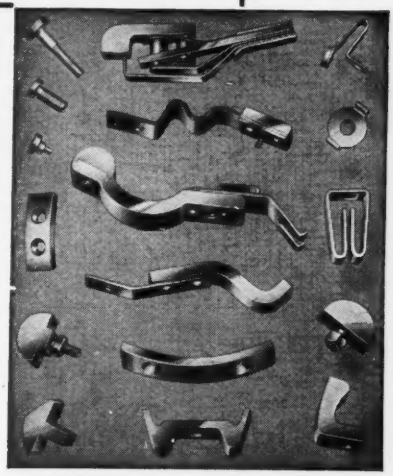

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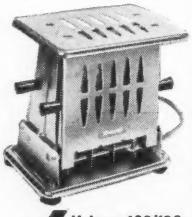

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Voltage: 100/120, 200/220, 230/250, AC/DC

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—the portable food mixer with the big performance and the biggest of all sales appeal!
Voltages 100/125 200/250 (A.C./D.C.)

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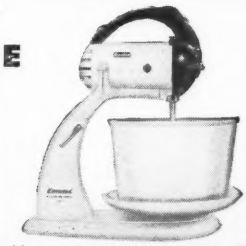

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FINISH: BLACK

List Price
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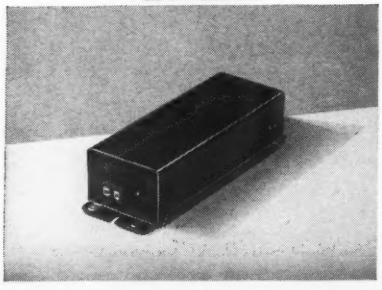
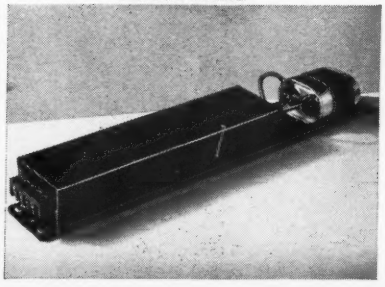
£1.2.6





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WIDTH: 2½"
F/CENTRES: 13½"
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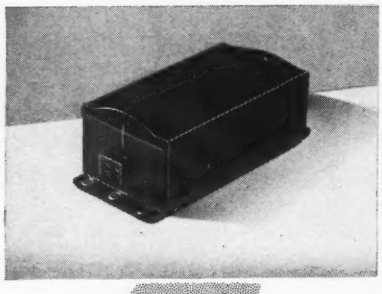

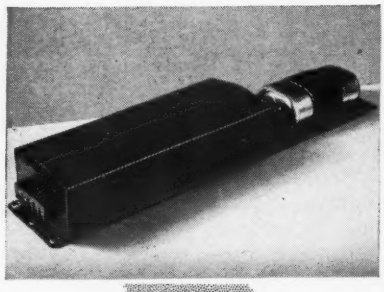

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HEIGHT: 2½"
WIDTH: 3"
F/CENTRES: 14½"
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List Price
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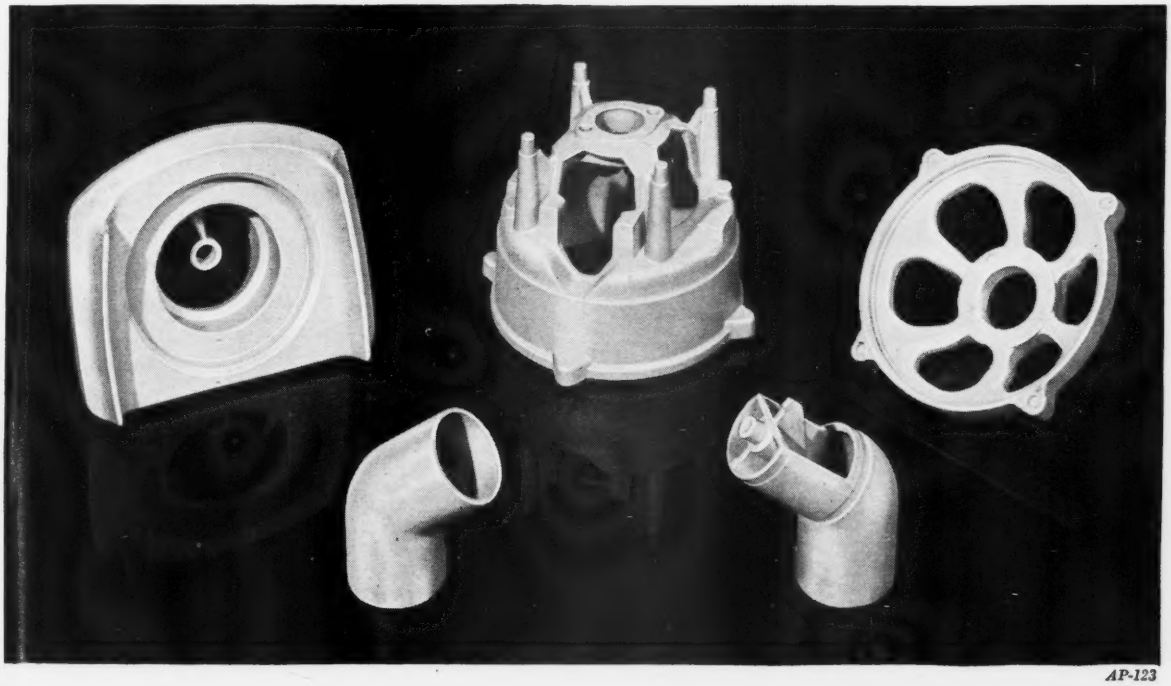

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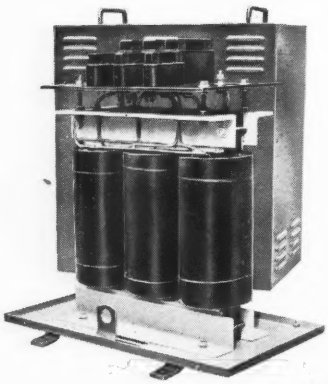

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in silicon steel, grain oriented steel,
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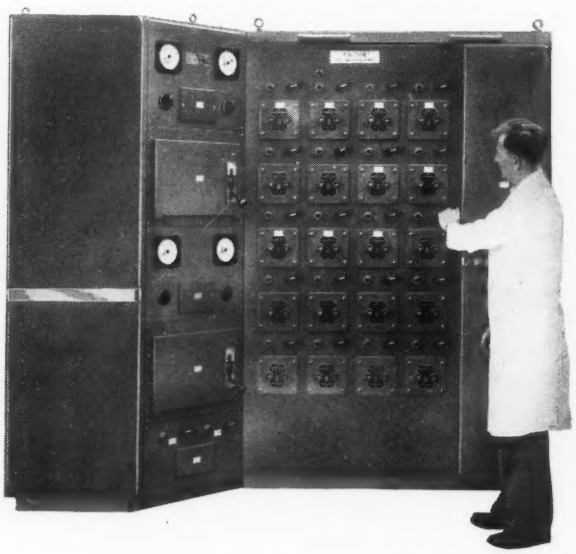

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Approved by C.E.A.

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Otter

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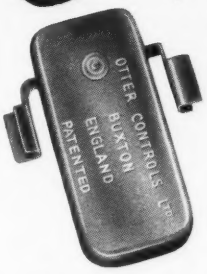

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- MINIMUM RADIO INTERFERENCE
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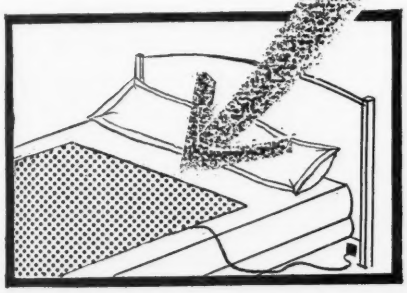

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BLANKET SAFETY CUT-OUT

When fixed in electric blankets or pads complying with B.S. 2612 and B.S. 1789 the Otter Snap Action Blanketstat and Blanket Cut-out will satisfy the relevant requirements.

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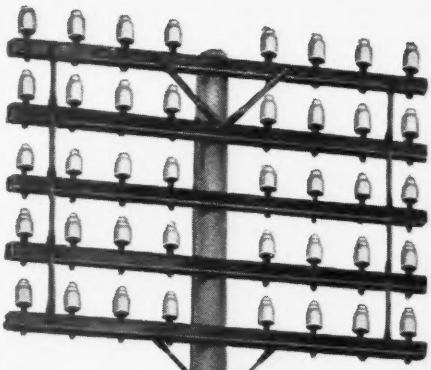

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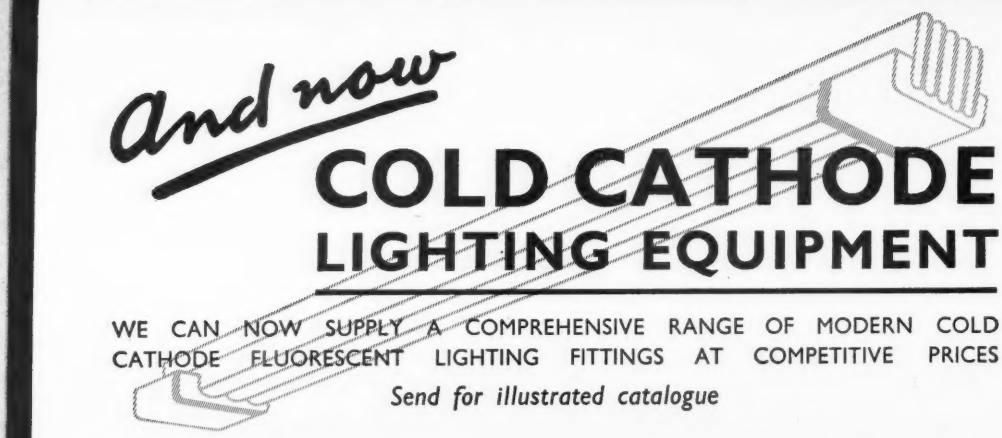

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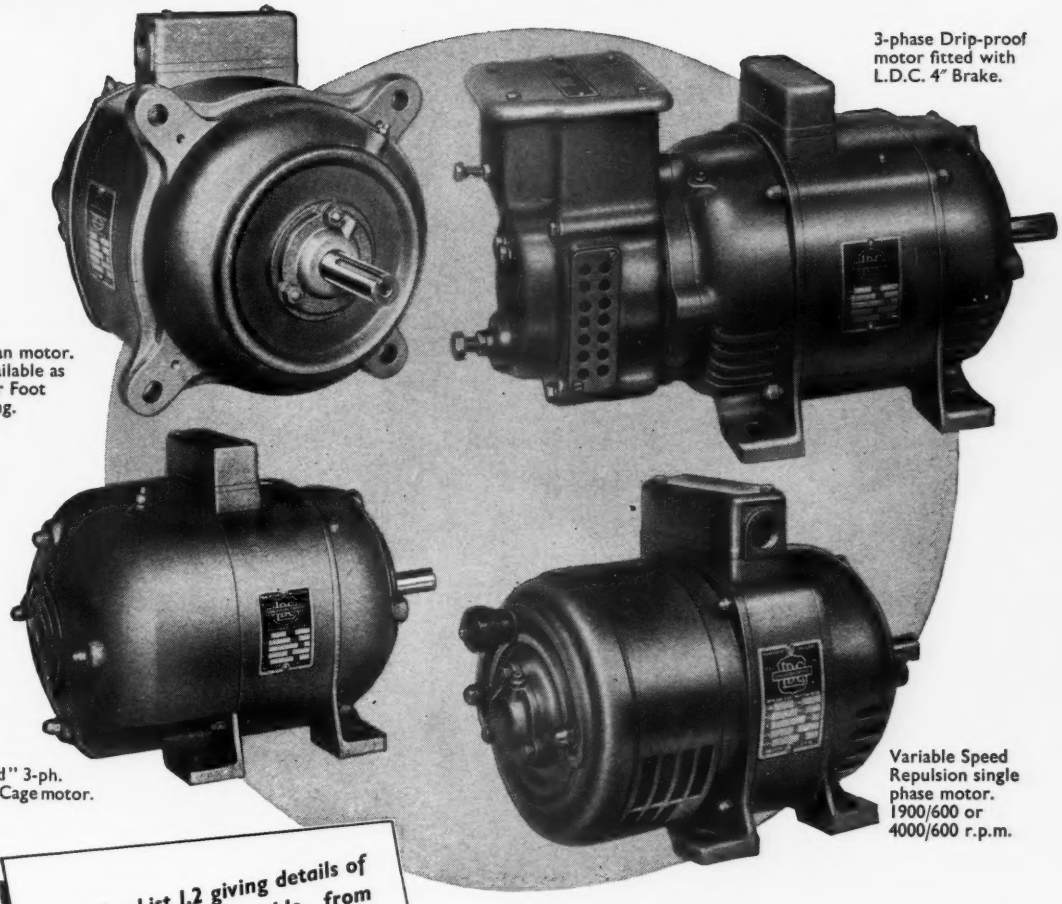

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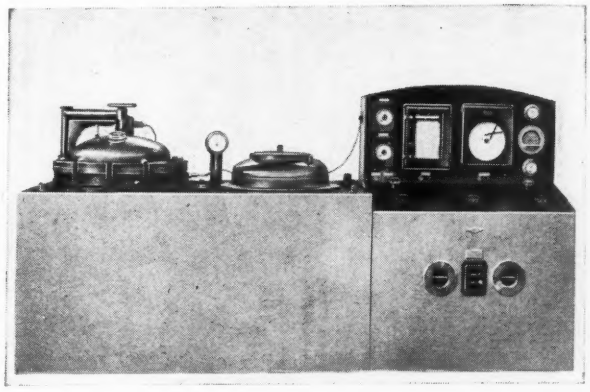

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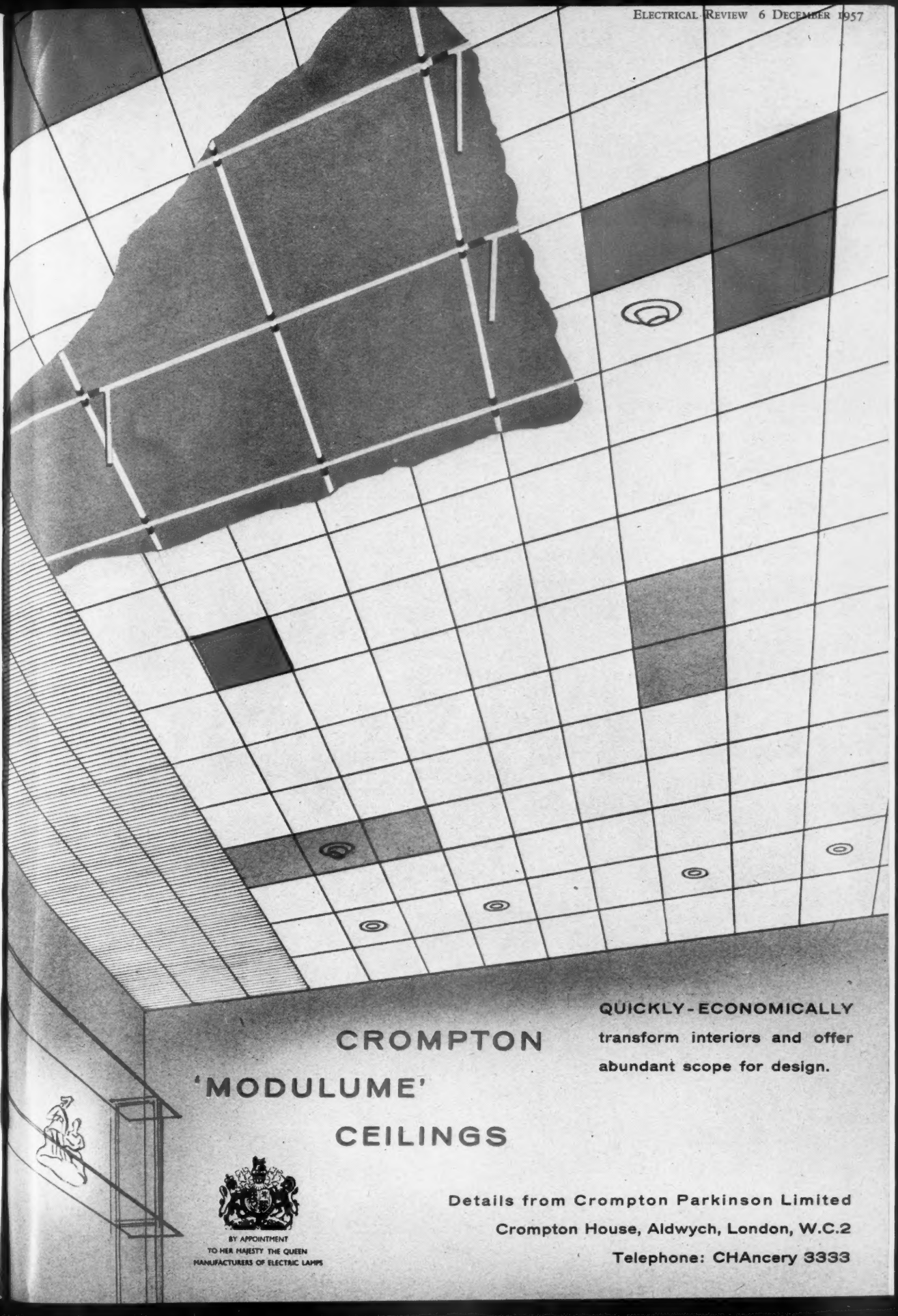

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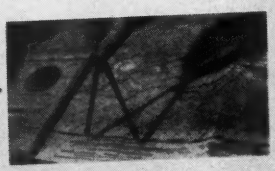

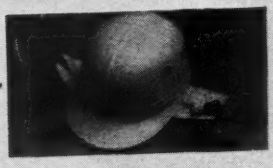

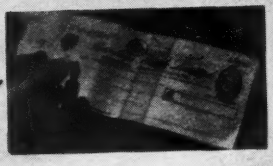

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across a continent of ice

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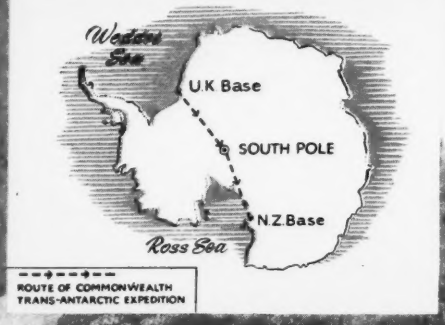

The study of the Southern Ice Cap will be undertaken from twenty-two observatories set up by eleven countries. It is hoped to determine the thickness of the ice over the whole continent and to map the coastlines covered by ice.

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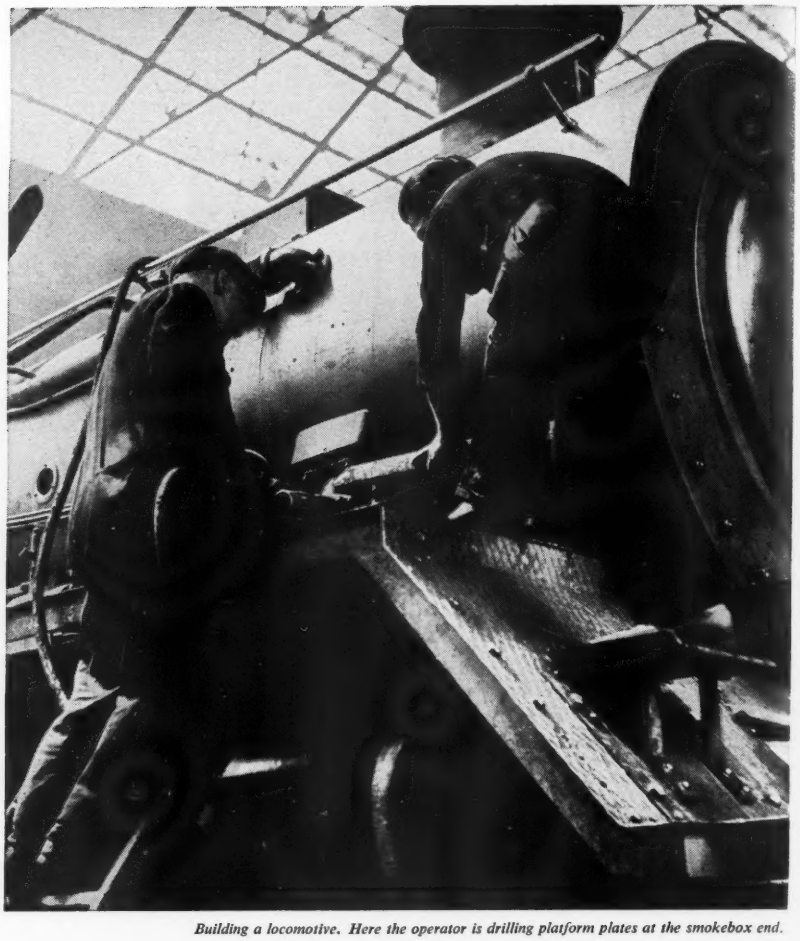

Building a locomotive. Here the operator is drilling platform plates at the smokebox end.

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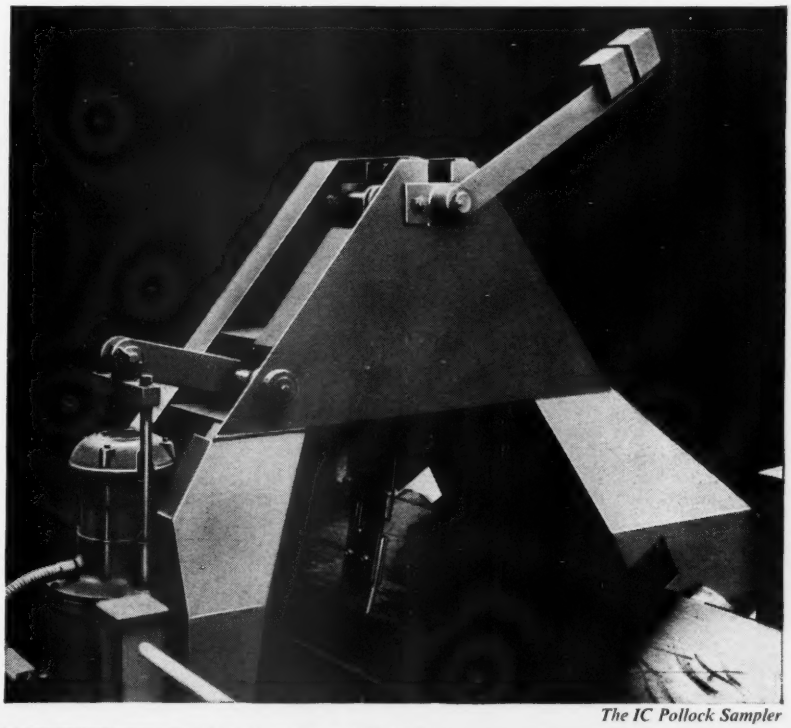
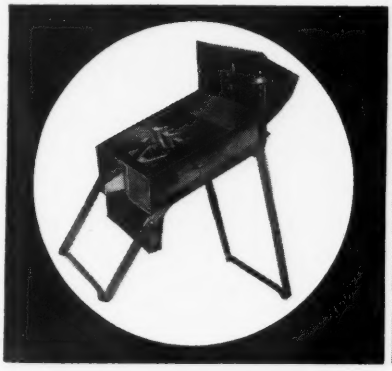


The IC Pollock Sampler



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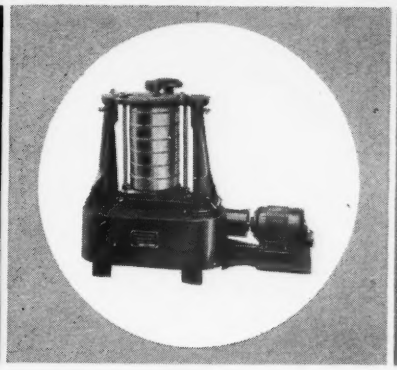
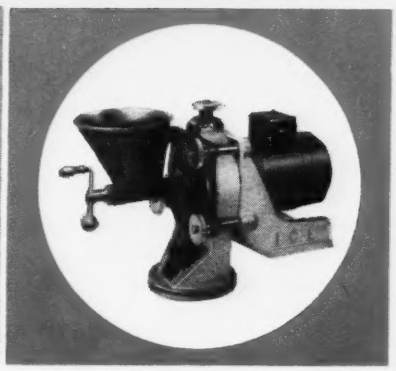


THE ROTARY SIEVE SHAKER
provides a uniform mechanical shaking method from test to test. It handles up to thirteen 8-in. diameter sieves in a single operation.



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DELCO Electric Motors

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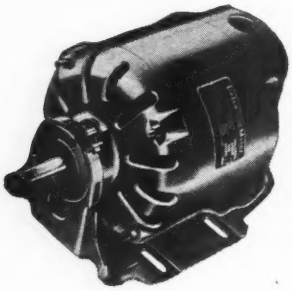
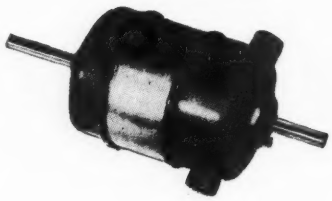
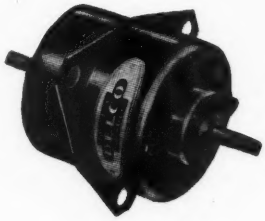


DELCO 6¼" TYPE



DELCO 310 TYPE



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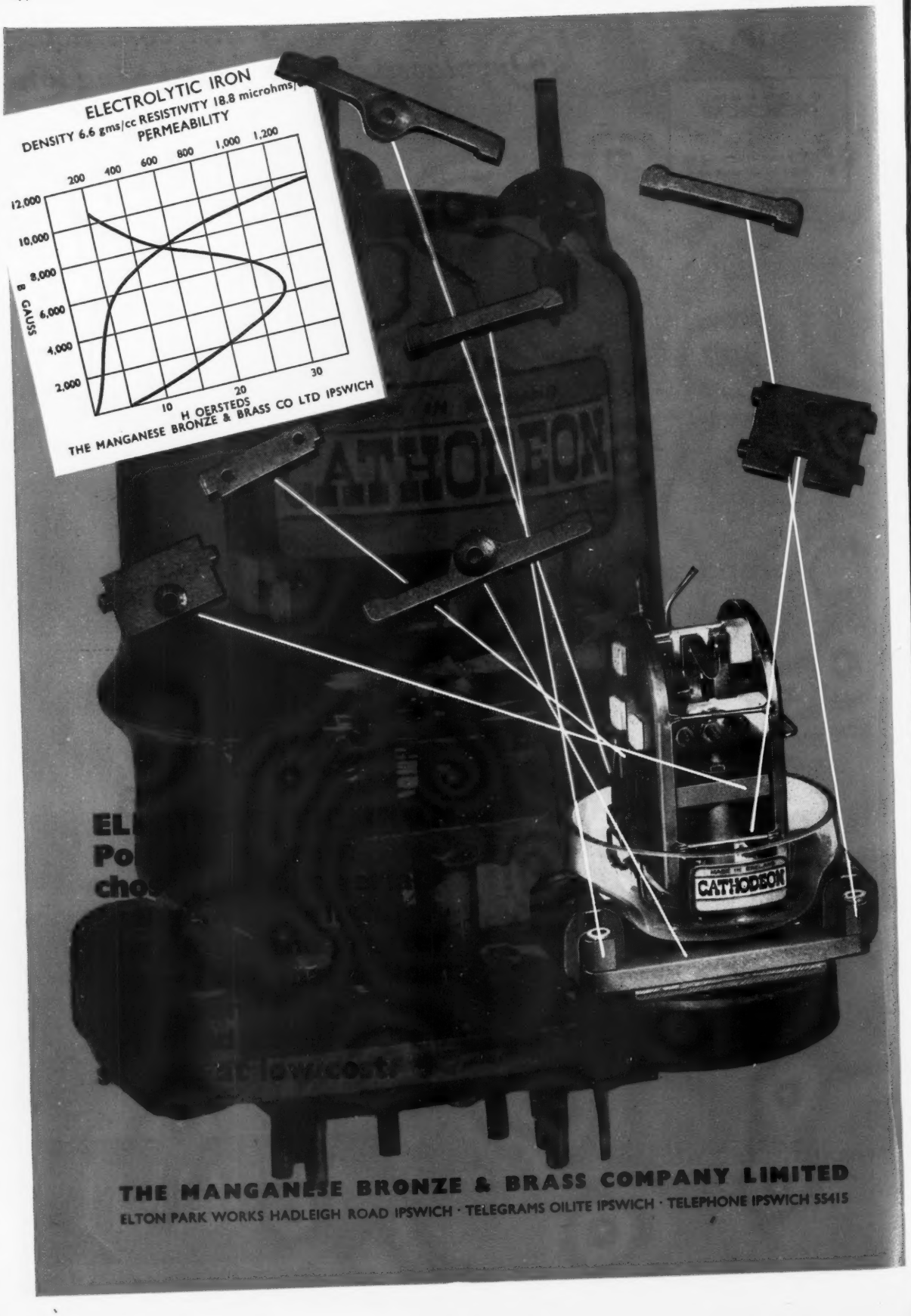
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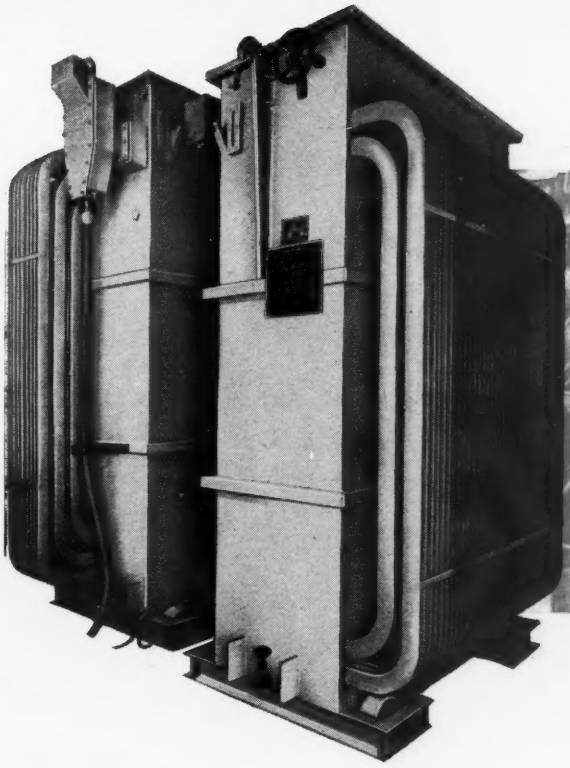
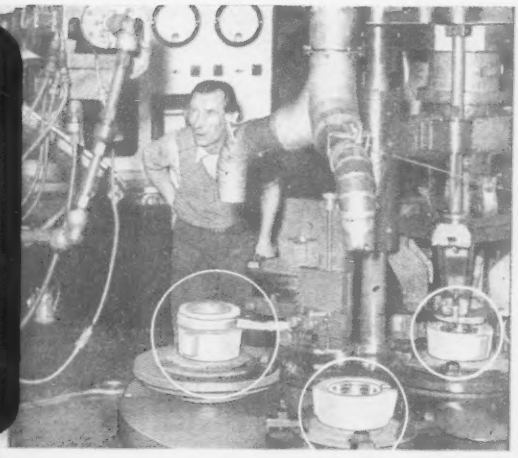


Photo by kind permission of the British Heat Resisting Glass Co. Ltd.



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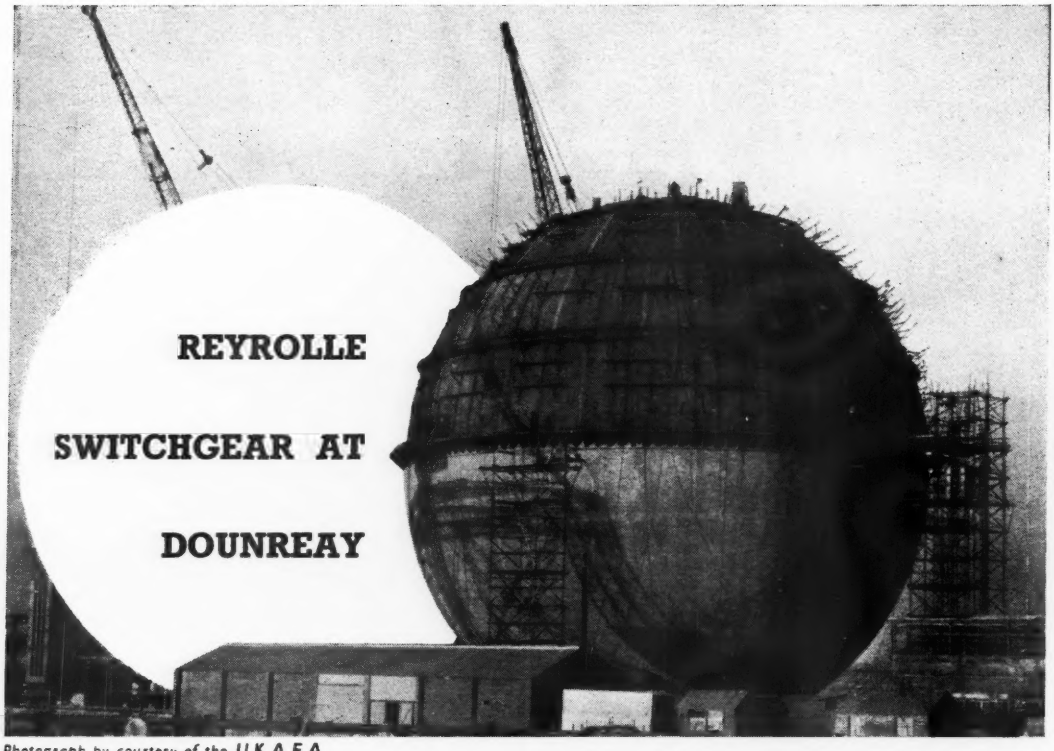

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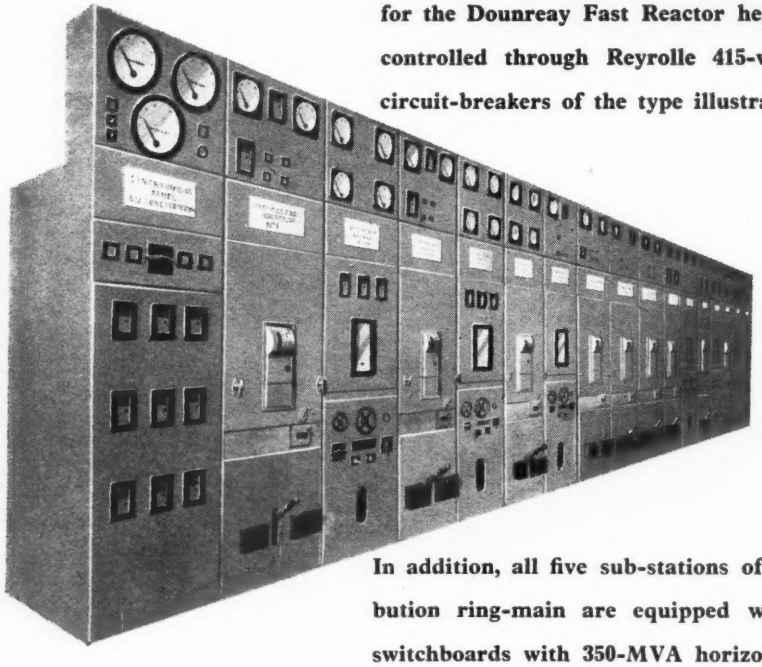

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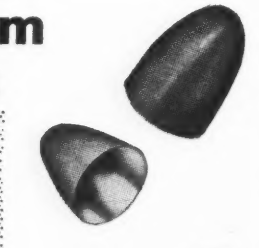

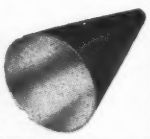

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Most useful and economical for the home, the office, the sick room, or when travelling. Boils water in a minute. Ideal for early morning cup of tea, shaving, etc.

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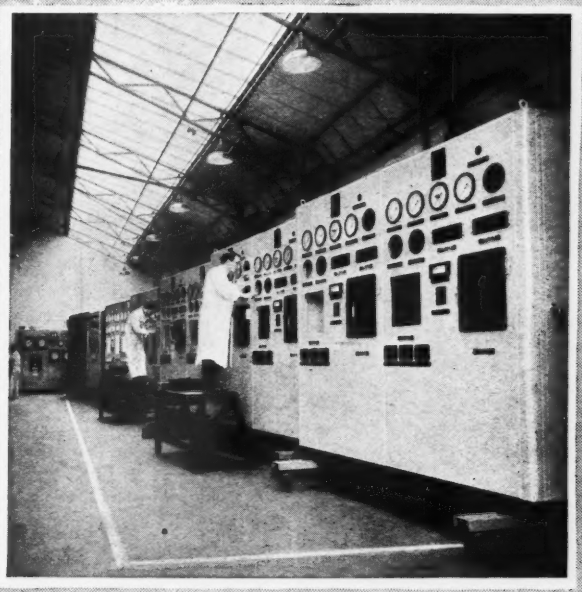
The John Thompson Instrument Company constructs and installs complete instrument panels including wiring, pipework and commissioning, employing John Thompson or other specified instruments. They manufacture Indicators and Recorders for the flow of steam, gases, air, water; fuel combustion control, pressure and draught indicators, cupola blast indicators, water hardness recorders, remote controls and special purpose devices.



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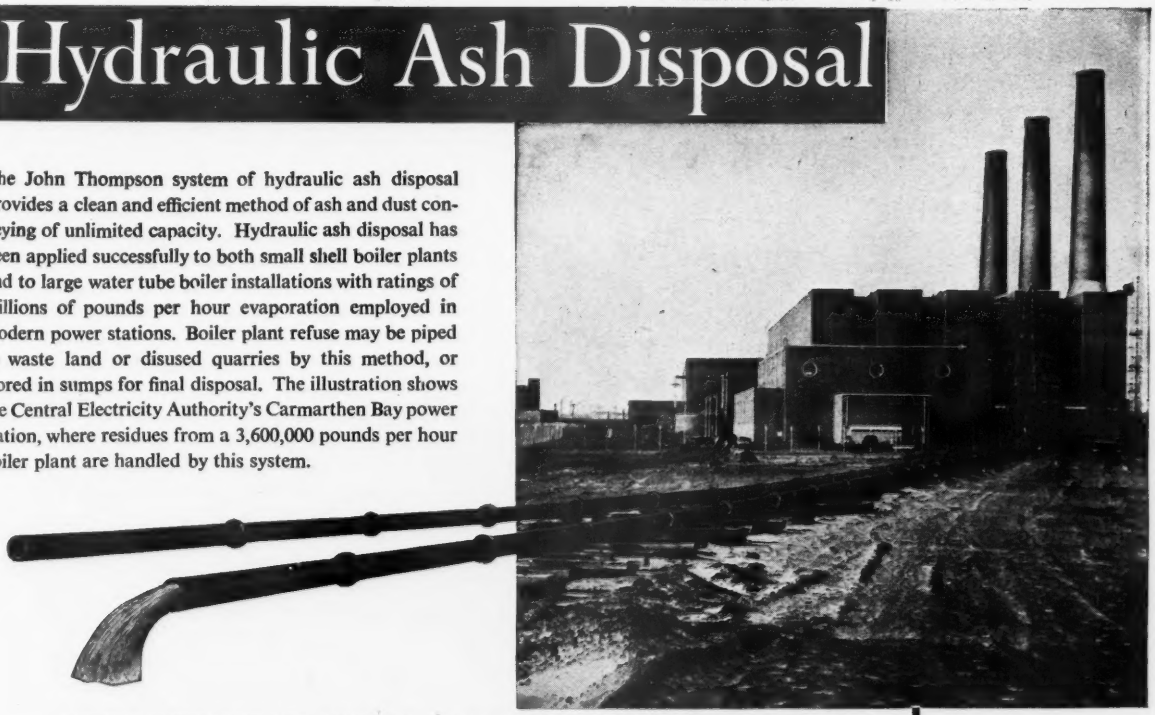
The John Thompson system of hydraulic ash disposal provides a clean and efficient method of ash and dust conveying of unlimited capacity. Hydraulic ash disposal has been applied successfully to both small shell boiler plants and to large water tube boiler installations with ratings of millions of pounds per hour evaporation employed in modern power stations. Boiler plant refuse may be piped to waste land or disused quarries by this method, or stored in sumps for final disposal. The illustration shows the Central Electricity Authority's Carmarthen Bay power station, where residues from a 3,600,000 pounds per hour boiler plant are handled by this system.



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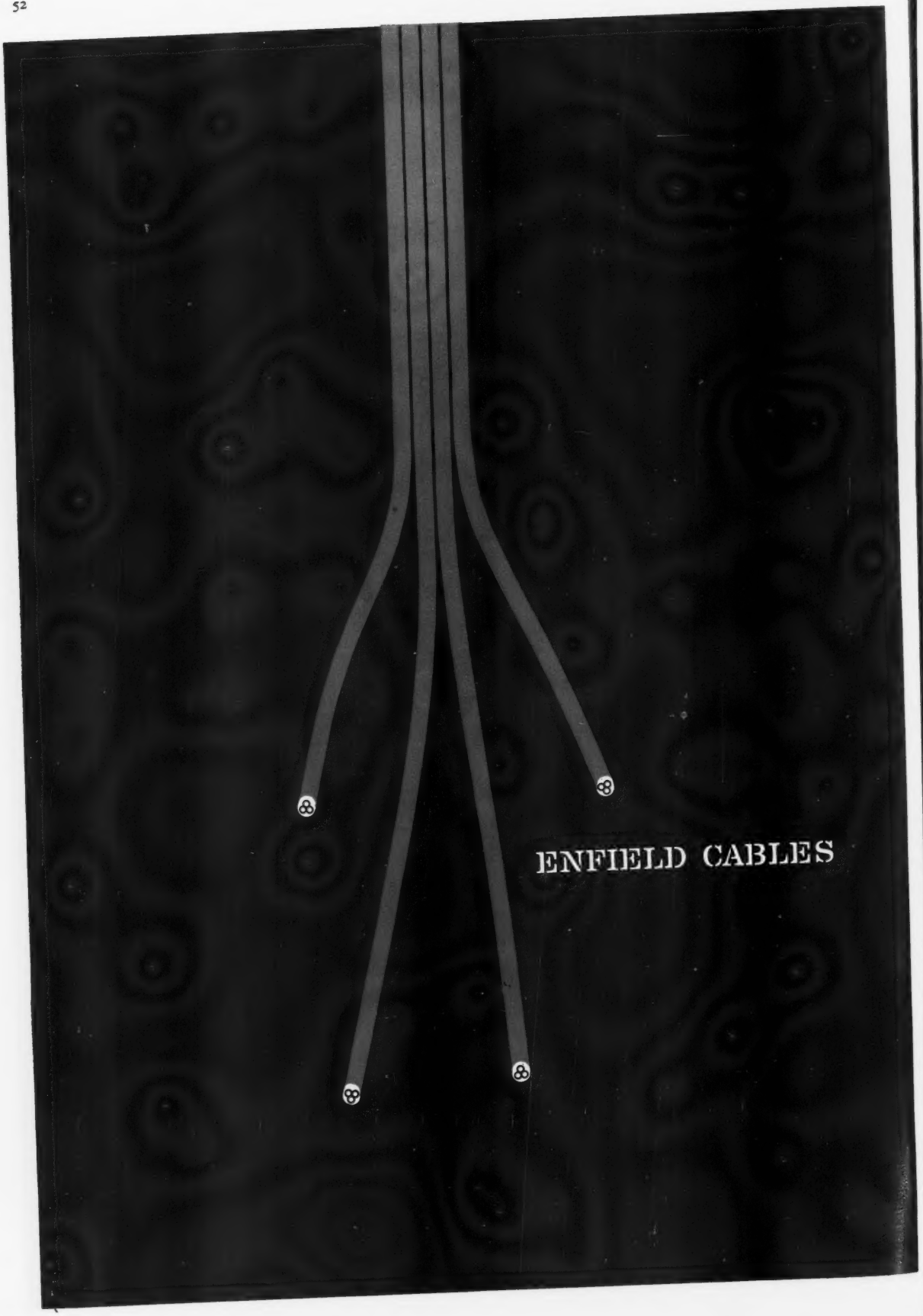
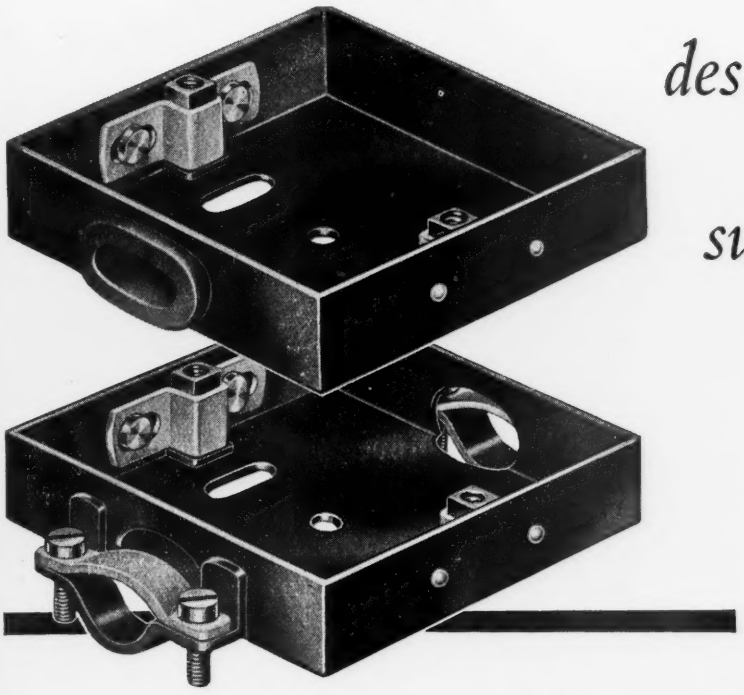

ENFIELD CABLES

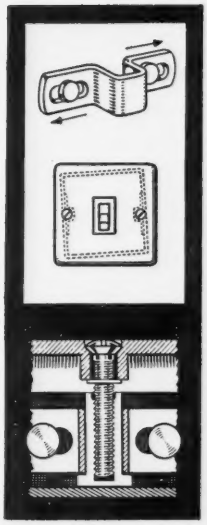


designed for adjustable switch fixing . . .

and to meet I.E.E. Regulation 403 (VII)

The adjustable lugs of these new Crabtree plaster-depth boxes permit the switch to be erected squarely on the wall irrespective of box mounting inaccuracies. They also have tapped nylon inserts which completely insulate the switch-fixing screws from all metal parts in compliance with I.E.E. Regulation 403 (VII).

Two types are available : one with bushed entries for use with rubber-covered cables ; the other with grip entries for either round or oval conduit.



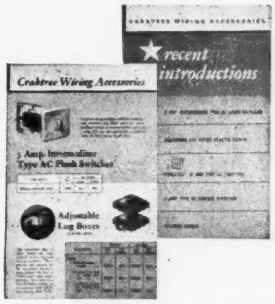
Both lugs may be moved in either direction.

Switch unit can be mounted correctly even where box is " out of square."

Switch-fixing screws are completely insulated from all metal parts.

CRABTREE adjustable lug boxes

For "Lincoln" 5 amp. Type AC Flush Switch Units



Listed particulars of Crabtree adjustable lug boxes will be found in Publication No. 1190, copies of which are available on request.

J. A. CRABTREE & CO. LTD., LINCOLN WORKS, WALSALL, STAFFS. C763

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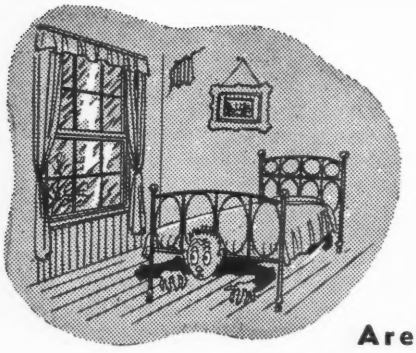

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for remote control of starters, etc.
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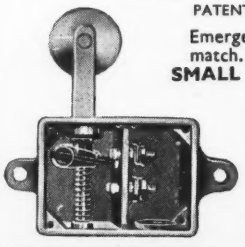
Emergency type **STOP** BUTTON to match.



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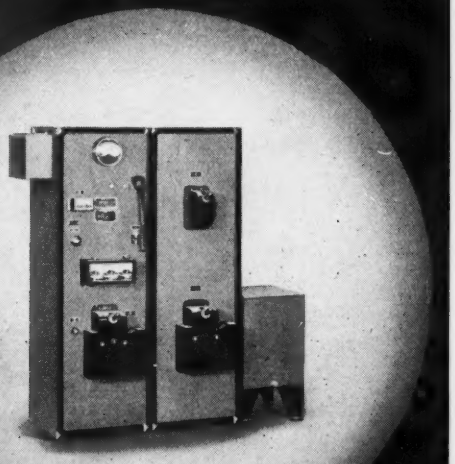
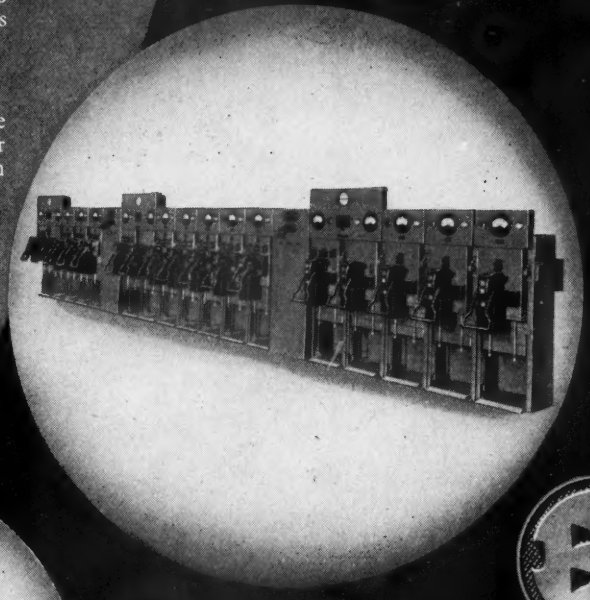
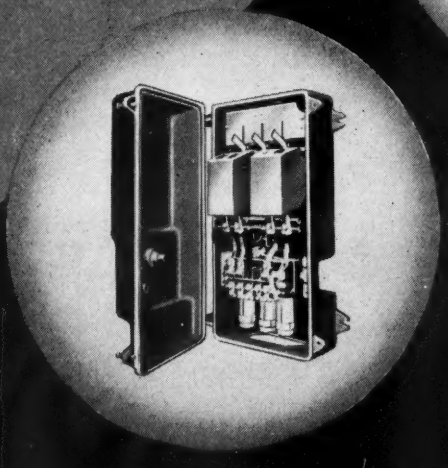
The middle illustration shows 400 Volt Vertical Isolation Switchboard containing CIRCUIT BREAKERS ASTA tested to 25 MVA at 400 Volts to BSS. 116.

Below is one of our contactor type direct-on STARTERS. All our Starters and Switchgear are fitted with magnetic type solenoid overloads.







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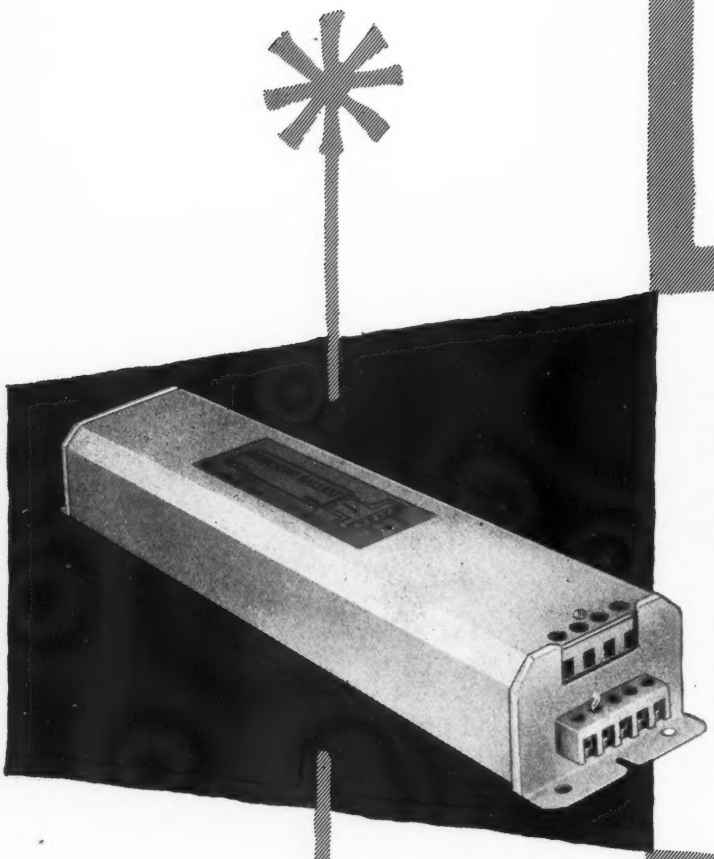
A705

a new twin tube ballast



This new type MIDCOIL Twin Tube Ballast is designed to operate two 5 ft 80 watt tubes.

The Unit is a Transformer Start Ballast for use in conjunction with a 6.8 MFT 440 Volt Series Capacitor operating tubes as series pairs and becomes inoperative if either tube fails. Available Bitumen filled or Bitumen free.

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his dad uses

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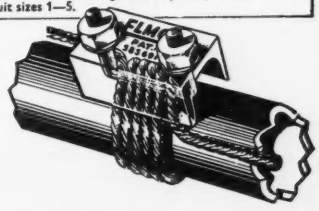
A COMPLETE RANGE TO B.S.951. 1948 IN 4 SIZES

	A123	B45	C67	D8910
for earthing cables up to	7/0.036"	7/0.064"	19/0.064"	19/0.083"
to fit B.S. conduit sizes	1, 2 & 3	4 & 5	6 & 7	8, 9 & 10
i.e. in trade terms	½" to ¾"	1" and 1¼"	1½" and 2"	2½" to 3½"

NOTE ALSO: Type A123 is suitable for Earthing Cables up to 7/0.029" and for B.S. conduit sizes 1—5.



"Elmo" Earthing Clamps are of robust construction. Impossible for wire to pull out, always under tension, therefore a most satisfactory earth and a permanent safeguard.

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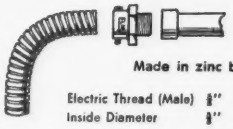

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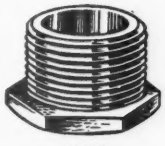
CONDUIT COUPLINGS

Made in zinc base alloy in the following sizes

Electric Thread (Male)	⅜"	½"	1"	1¼"	1½"	2"
Inside Diameter	⅜"	½"	1"	1¼"	1½"	2"
Electric Thread (Male)		⅜"	½"	1"	1¼"	
Inside Diameter Flexible Conduit		¼"	⅜"	½"	¾"	1"

WITH EARTHING TERMINAL

Special Features: Integral Earthing Terminal, tinned ready for soldering. Fixing screw for continuity. Internal threads suit all makes of flexible tubing.



MALE
Hex. Section

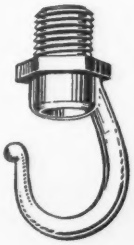
CONDUIT BUSHES

Made in the following sizes:

MALE: Electric Thread
⅜" ½" 1" 1¼" 1½" 2"

FEMALE: Electric Thread
⅜" ½" 1" 1¼" 1½" 2"

FEMALE
Flat Face Section for Spanner (except ⅜" size, which is round)



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For fluorescent lamps and overhead lighting fittings. Screwed ⅜" thread, male electric.

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Both made in aluminium alloy

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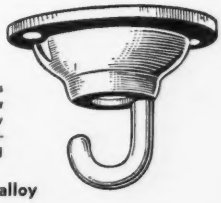

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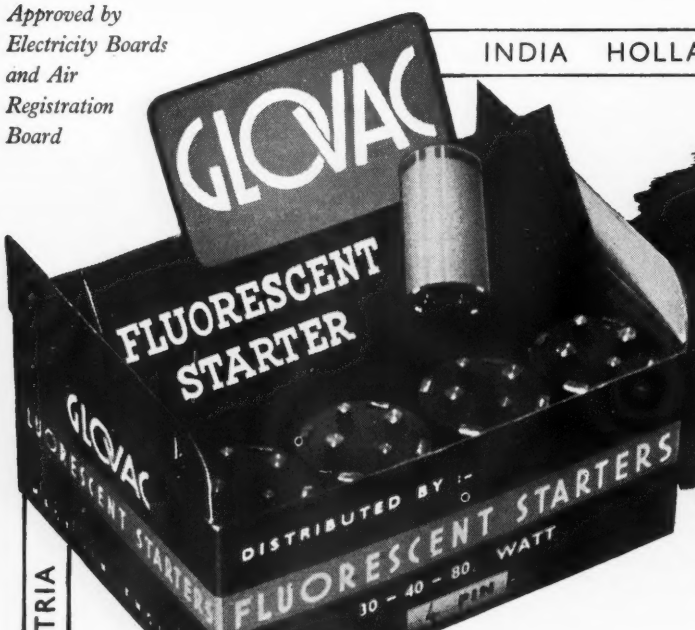

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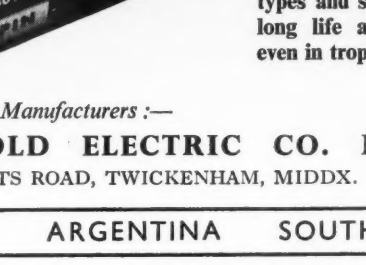

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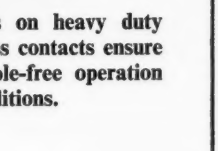
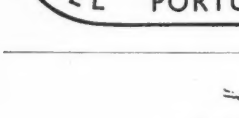


for ENGRAVED NAMEPLATES—



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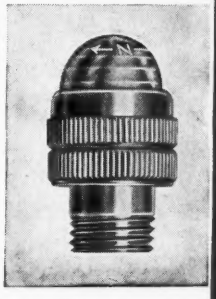
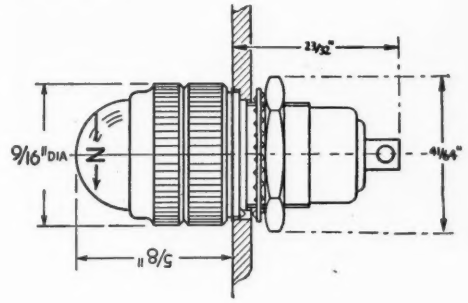
LAMPHOLDER

SHORT AND LONG SHANK VERSIONS

This lampholder represents an outstanding advance in space-saving—the outside diameter of the complete device is only $\frac{9}{16}$". Here, then, is the smallest of all dimmer indicator lamps. The cap contains a rotary shutter with built-in stops to restrict rotation between the fully-shuttered and the fully-open positions. When fully shuttered there is sufficient illumination for night vision. Glass lenses are engraved with the direction of rotation and letters indicating night and day conditions.

The short shank version is designed for panel fitting where there is no "Plasteck" panel intervening between the indicator cap, and the lampholder. The long shank version is for use where a "Plasteck" panel intervenes and/or where the extended length may be necessary to suit special installations. Both components are designed to screw into the standard lampholder body used for Plasteck lighting L/H body 80/10/0063 earth return. This can be supplied as double pole version if required. Colour of cap: red, green, amber, blue or clear. Can be supplied with 28V, 12V or 6V bulb.

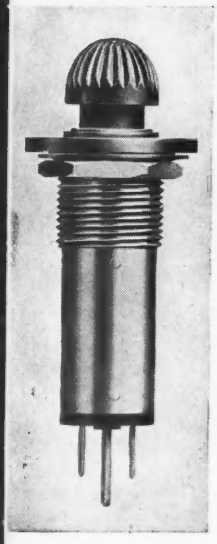




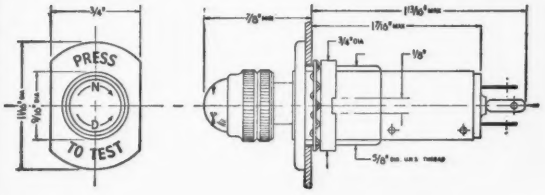
AND THE MINIATURE

PRESS-TO-TEST

FITTING



Extreme compactness has been achieved in this new "Press to Test" component. For installation a round hole $\frac{11}{64}$" diameter is all that is necessary in the mounting panel. The component can be extracted from either the front or from the back of the panel. There are two versions one with 3 terminals (solder or screw 1 terminal common) and the other with 5 tag terminations, solder (1 terminal common). The internal contact assembly are so arranged as to be free from normal aircraft vibration conditions and pre-determined contact pressures are maintained in the design technique. The front indicator plate can be engraved "Press to Test" or for any other engraving to suit operational requirements. The lampholder cap may be either the indicator or rotary shutter type. Colour of cap: red, green, amber, blue or clear. Can be supplied with 28V, 12V or 6V bulb.



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Putting two and two together and making five ! At least, that's how it appears when you consider the saving in time and cost by changing over to tapping screws.
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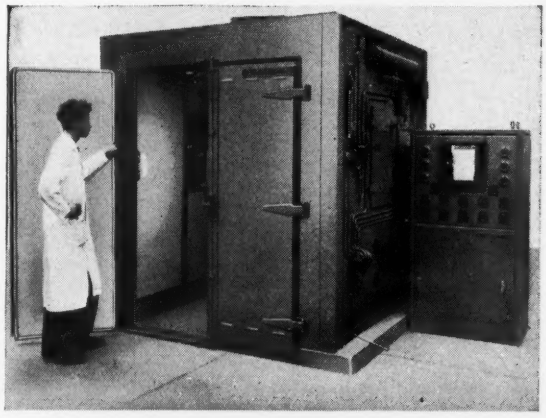
'B-W' Tropical Chambers
and Humidity Cabinets for Climatic Tests



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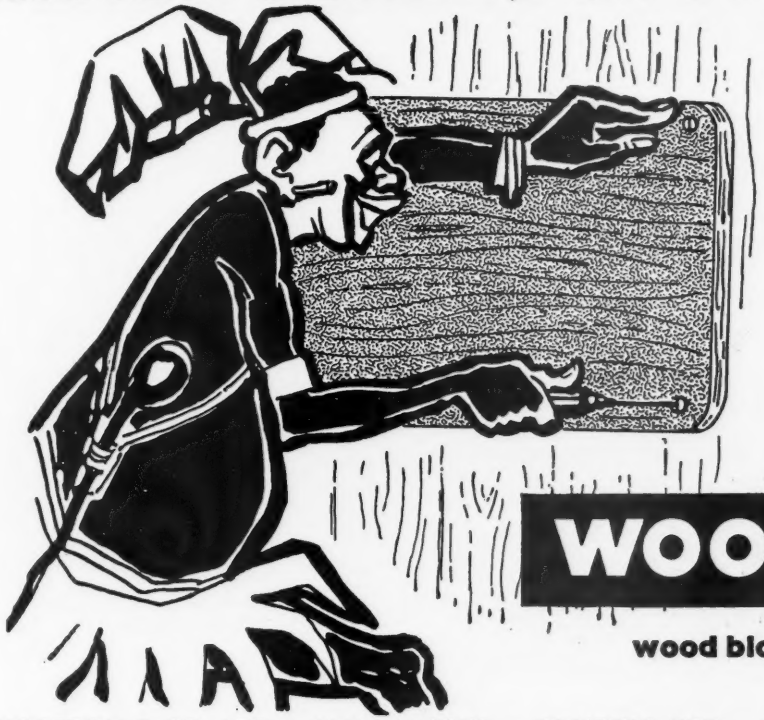

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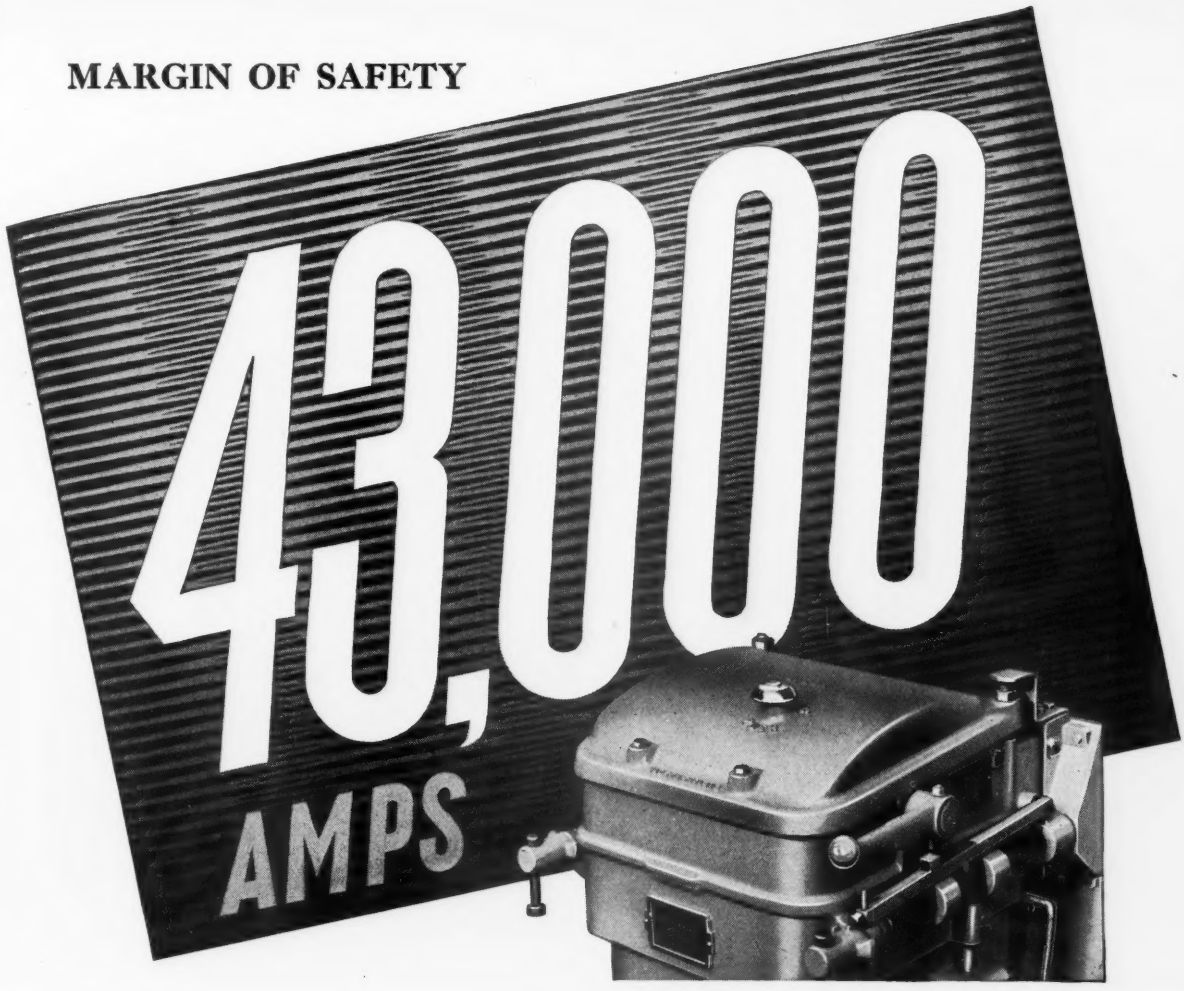

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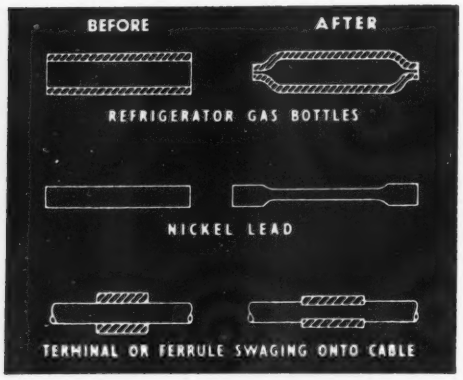

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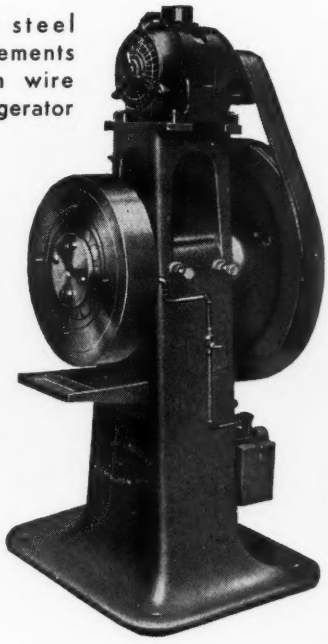

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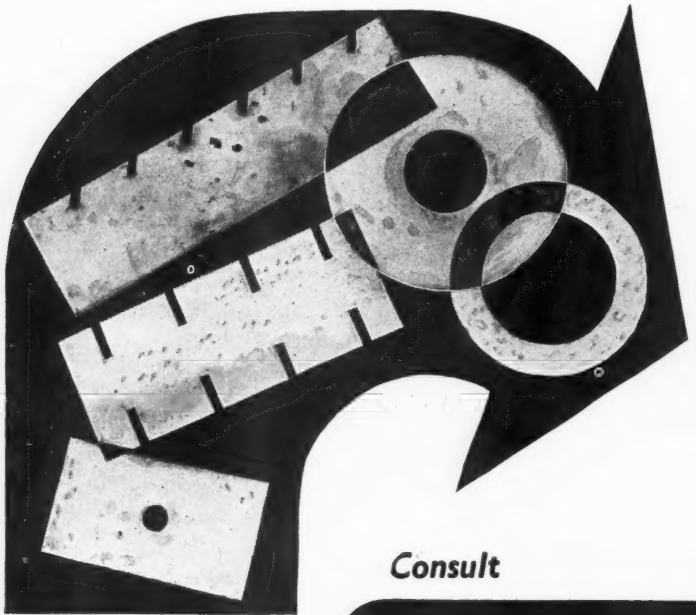

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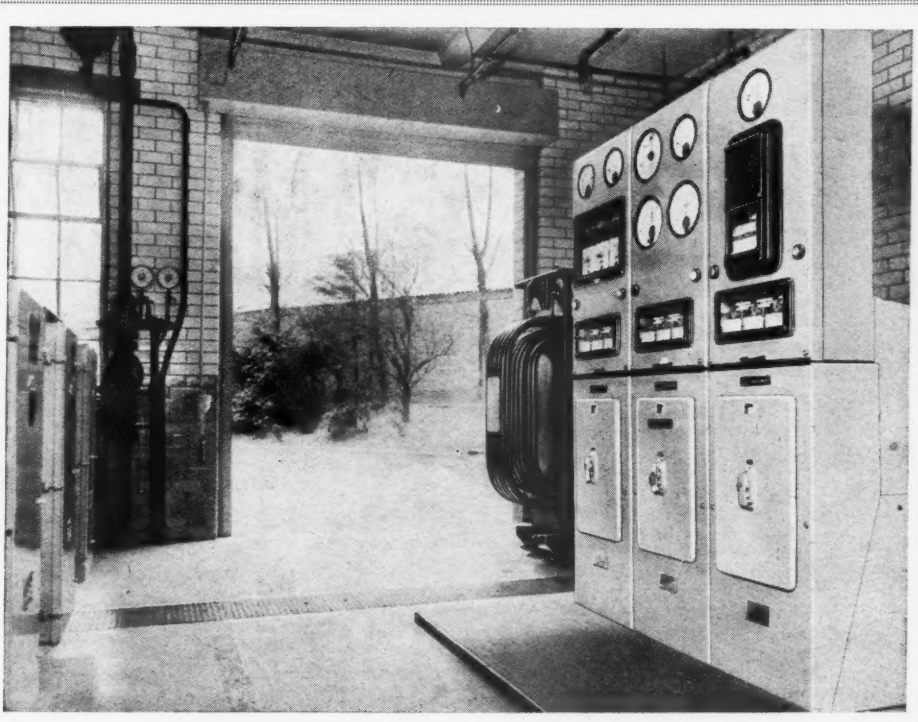

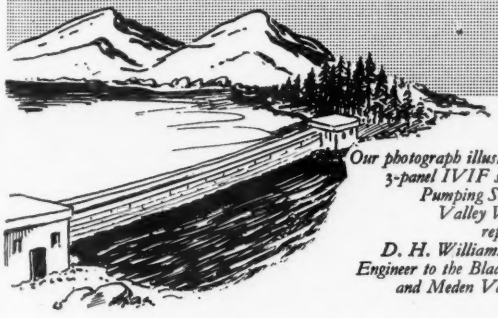

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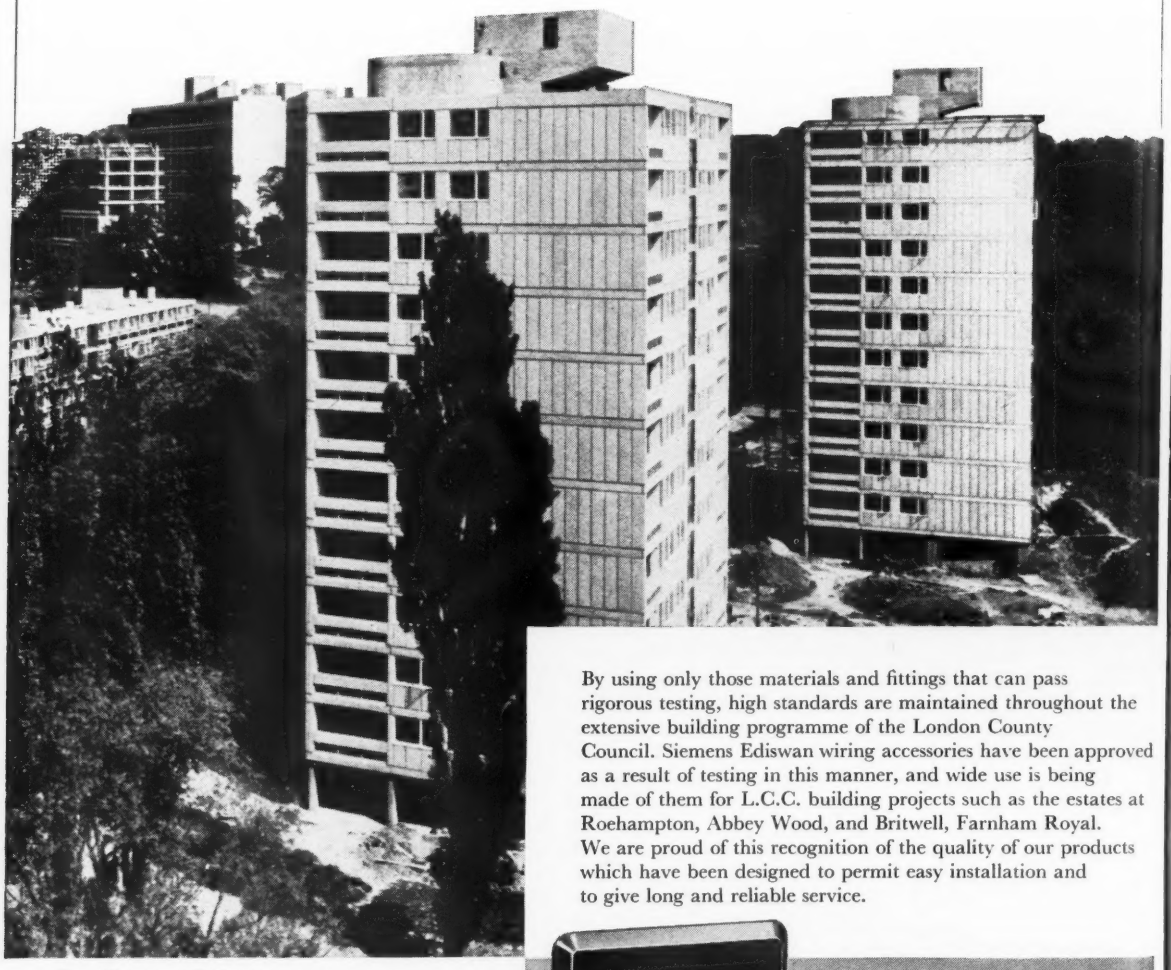

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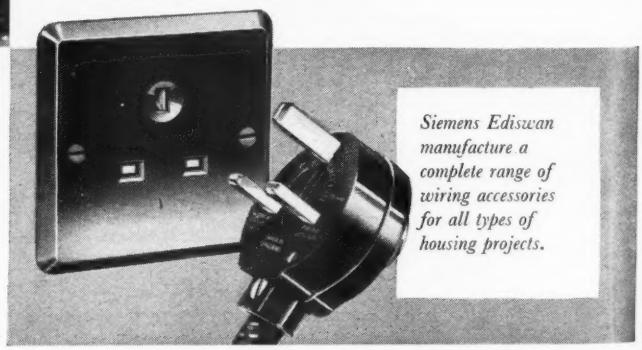

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ELECTRICAL REVIEW

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In This Issue

Reheat and Thermal Efficiency	1009	Despite such things as slight non-uniformity in temperature gradient the large high temperature turbines of the current programmes may be expected to attain new high standards of smooth running and operational flexibility
Reheat Steam Turbines	1011	A major problem with reheat turbines is control against excessive rise in speed with sudden loss of load. Normal load variations in service can be controlled by the action of the high pressure inlet governor valves. If load were suddenly lost, through the electrical tie with the grid being broken, the inlet governor valves would shut off the live steam supply owing to the consequent rise in speed
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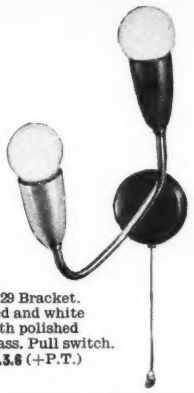

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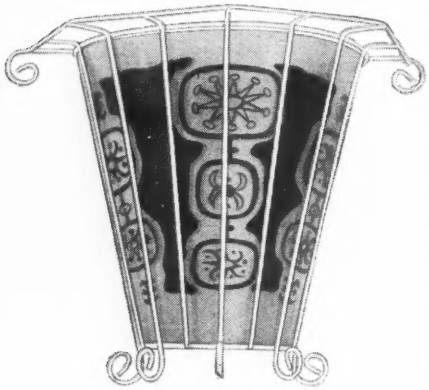

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ELECTRICAL REVIEW

6 December 1957 Vol. 161 No. 23 Established 1872

Reheat and Thermal Efficiency

THE design of British electrical generating plant is passing through a phase of intense development which recognises the steam turbine, working on the reheat cycle, as the main source of new power during the next decade or so. The Central Electricity Authority has, of course, played a major part in determining the course of development, and the studies of its engineering staffs, based on the wealth of experience and co-ordinated knowledge available to them, have enabled the Authority to encourage the manufacturing industry to co-operate in a rapid drive towards the fulfilment of the ultimate that the resources of current technology, expressed as sound engineering, has to offer.

It is appropriate that the competent survey of significant features of reheat turbines, contributed to this issue by Mr. J. C. London, should extend to the large machines now projected by the C.E.A. It will be recalled that Mr. London is also the author of a paper on " Improvements in Thermal Efficiency due to Single-stage Reheating."

The case for reheat depends on increased thermal efficiency, set against greater cost and complexity; complexity being accepted, the choice becomes largely economic, dominated by the cost of fuel. It is noteworthy that Mr. Norman Elce, in his "Economic Basis and Character of Steam Turbine Design," concludes that the reheat cycle is advantageous down to outputs of below 60 MW. This view is increasingly supported by Continental and American practice.

However, reheat turbines are usually large turbines; indeed, a 60 MW turbine is still a large turbine. They are large turbines in which a greater portion operates at high temperature. It is worth recalling, in this connection, that for a given speed of rotation, 0·001in transverse distortion of a rotor due, say, to slight non-uniformity in temperature gradient, has the same significance in a large turbine as in a small one, although representing a much higher standard of maintained accuracy in the large turbine. The out-of-balance centrifugal force will be the same proportion of the rotor weight in both turbines.

Despite this, the large high-temperature turbines of the current programmes may confidently be expected to attain new high standards of smooth running and operational flexibility. Detail developments in rotors, casings and structural features generally, bearings, glands, couplings and in supervisory instrumentation and the testing of safety devices, all proceeding in parallel with the more limiting developments

controlled by stress and similar considerations, have made marked progress to this end. With nuclear base load stations round the corner, all these large machines are designed to be suitable for the starting schedules of shift operation, although it is perhaps in the technique of such starting that experience, allied to scientific "know how," most completely retains its traditional value.

BETTER THAN EXPECTED

Complaints always provide better news than satisfaction. That is why people overseas are more aware of any shortcomings of British manufacturers and exporters than of work well done. And we ourselves are prone to reprove our fellows rather than praise them. Consequently we are not surprised that Mr. Gordon Churchill, the Canadian Minister of Trade and Commerce, and leader of the Canadian Trade Mission which is at present touring this country, was impressed by the efficiency of some of the factories he had visited, the degree of automation, the amount of research being carried out and the methods of training. Another member of the Mission was agreeably surprised, after what he had heard, to find that the workers in the factories were really pulling their weight, comparing favourably in this respect with their transatlantic counterparts.

While a certain amount of this praise may be attributed to the politeness of our guests, it is still true that British manufacturers and their employees are not so bad as they are often painted as, indeed, this country's export achievements have proved.

G.E.C. BOARD CHANGES

As was to be expected, the retirement of Sir Harry Railing as chairman and joint managing director of the General Electric Co., Ltd., and the appointment of Mr. Leslie Gamage as head of the G.E.C. organisation has necessitated a number of changes in the board of directors and, as we report elsewhere in this issue, the opportunity has been taken to create three new positions of assistant managing directors and to appoint two new directors. The assistant managing directors are Mr. T. W. Heather, Mr. A. L. G. Lindley and Mr. R. E. Robinson, and the new directors are Mr. D. G. W. Acworth and Mr. W. J. Bird.

All have a long record of meritorious service with the G.E.C. and each is a specialist in the particular sphere of the company's activities for which he will be responsible. The changes will strengthen the direction of the company's affairs, and, of course, it can still call upon the wide experience and judgment of Sir Harry Railing, who remains a member of the board.

TELEPHONE AUTOMATION

Magnetic drum storage techniques, similar to those employed in some of the latest types of computers, are used in the electronic telephone controlling equipment which was put into operation at the Lee Green, London, telephone exchange last week. This equipment, which is in the nature of a field trial, replaces in a comprehensive way the directors and other associated switches which normally in an exchange of this kind are of the electromagnetic variety. The magnetic drum and its associated electronic equipment can be time shared over 114 switch control units in as little as 17 millisec, each without interfering with any other. Moreover, each of the 114 control units can be re-scanned every 17 millisec so that changes in state of up to 60 per second are recognised. This permits considerable economies in apparatus and is one of the reasons for developing the trial equipment.

Developments in switching techniques such as this are the outcome of a continuing programme of intensive research and development by the principal British manufacturers of automatic exchange equipment and the Post Office. The present equipment is the first of its kind and it is anticipated that it will lead to increasing reliability. Although it is not spectacular it is a noteworthy forward step.

CALL FOR PREPAREDNESS

Whatever form the proposed European Free Trade Area may finally take, it seems certain that some scheme will be agreed upon before very long. Although its operation will be gradual it will not be wise for British manufacturers to remain passive until things begin to happen; they must, as Mr. Leslie Gamage urged in an address last week, take immediate steps to adapt themselves to the coming changes. Mr. Gamage considered that we would then have nothing to fear from competition; indeed we would strengthen our own competitive ability. Among other things, we would greatly enlarge our "home market" and thus be in a better position to exploit our own inventions instead of leaving their development to other countries.

Even without European Free Trade, said Mr. Gamage, there would have to be a "ferment" in British industry to make it increasingly competitive. In this he was, of course, repeating a truism often voiced but too infrequently followed. He said that we would have to concentrate on the production of those articles for which there was the greatest demand and not on those which it was easier to make. Under European Free Trade, it seems to us, each member country will have to produce those things which it is best fitted to make; there is bound to be a greater degree of national specialisation.

E.T.U. ELECTIONS

Much publicity has been given to the invalidation by the executive committee of the Electrical Trades Union of votes in certain branches for non-Communist candidates for office. The grounds for the executive committee's action are said to have been that the members in question were not fully paid-up and their votes were therefore ineffectual, but this is questioned by a number of the branches. So far the leading officials of the Union have declined to make any statement in public because they regard the matter as purely domestic. This may be so, but when a domestic matter is aired in public by a sufficient number of those involved it is desirable for responsible officials to give their views. If they have nothing to hide there can be no good reason for reticence.

REHEAT STEAM TURBINES

A REVIEW OF SOME DESIGN PROBLEMS

By J. C. LONDON
B.Sc., A.M.I.C.E., A.M.I.Mech.E.*

ALTHOUGH it would be interesting to consider the effects of nuclear energy on future power station design it seems probable that for many years a large proportion of electricity will still require to be generated by conventional steam plant in order to meet steadily growing demands for power. Continually rising fuel, maintenance, and capital charges, which make up the cost of generation, are justifying the increasing adoption of higher steam conditions and larger unit sizes of turbo-generator in modern power stations.

It is not always appreciated that to realise fully the improvement in overall thermal efficiency associated with increase of steam pressures and temperatures a corresponding increase in the unit size of the turbine is necessary; for a given output, higher pressures result in shorter, and less efficient, inlet end blade heights and proportionately greater spindle gland leakage losses. In addition, the largest unit possible consistent with load demands nearly always has the lowest capital cost per kW of installed plant capacity.

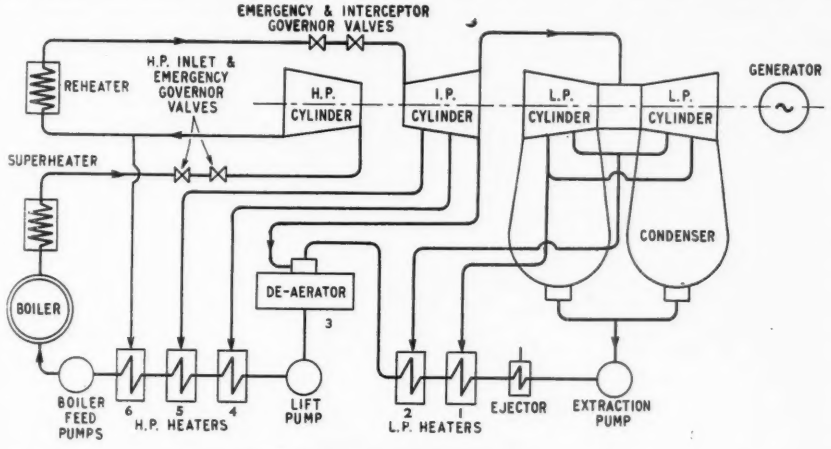


Fig. 1.—Diagrammatic arrangement of typical tandem-compound reheat set with feed-heating

As steam temperatures approach 1,050 deg F, scale formation problems and a rapid falling off in the creep strength of ferritic steels occur. Though austenitic steels are replacing ferritic at temperatures above 1,050 deg F, data are only slowly being accumulated on their properties when subjected to continual stress at high pressures and temperatures for many thousands of hours. In the normal non-reheating steam cycle, with stop-valve pressures exceeding about 2,000 lb/sq in, at a temperature of 1,050 deg F, excessive exhaust wetness occurs in condensing turbines with consequent blade erosion. If, however, after expansion part way through a turbine, the steam is again heated to a temperature at or approaching that at the stop valve, not only is there a corresponding reduction in the exhaust wetness but the thermal efficiency of the cycle as a whole is improved, due mainly to raising the average temperature of the total heat input. Reduced wetness also improves the turbine efficiency and steam consumption.

Fig. 1 shows the connections of a typical reheat set with six stages of feed-water heating. The choice of reheat pressure presents an interesting problem, Fig. 2 illustrating the effect of varying the reheat pressure for such a cycle; gains in thermal efficiency due to reheating over the efficiency of a non-reheat plant with the same stop-valve pressure and temperature are plotted against reheat pressure expressed as a percentage of the stop-valve pressure. The gain with reheating to 1,000 deg F for a stop-valve temperature of 1,000 deg F is shown by the full lines, there being little practical variation in this gain at stop-valve pressures between 1,200 and 2,400 lb/sq in. For curve "A," steam to the last high-pressure feed heater (No. 6 in Fig. 1) is bled from the high-pressure cylinder exhaust. The additional improvement from curve "B" is relatively slight and is obtained only at the expense of moving

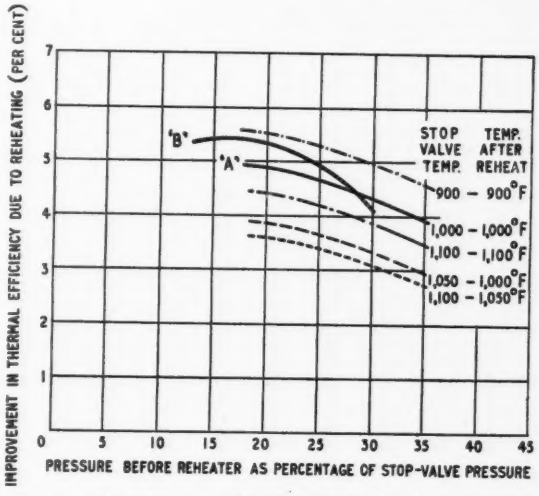


Fig. 2.—Improvement in thermal efficiency due to single-stage reheating

* Metropolitan-Vickers Electrical Co., Ltd.

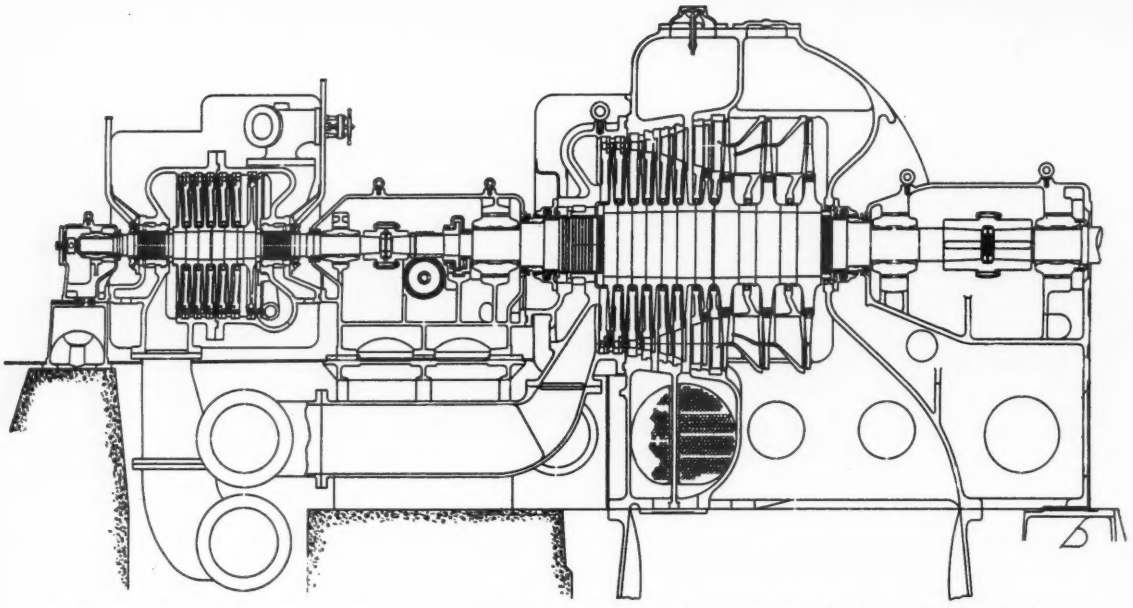


Fig. 3.—20 MW, 2,400 r.p.m. tandem-compound turbine for 450 lb/sq in, 650 deg F, reheating to 500 deg F (North Tees power station)

No. 5 heater tap (Fig. 1) to a point preceding the reheater and bleeding steam to No. 6 heater from a belt in the high-pressure cylinder with a corresponding final feed-water temperature some 50 to 70 deg F higher than for curve "A." With reheat pressures much below 20 per cent of the stop-valve pressure uneconomically large bore reheater piping and valves are usually required to avoid excessive steam velocities.

Subject to some variation due to differences in individual turbine and associated piping designs the value of the gain from reheating over non-reheating tends to fall off with increase in steam temperature. This change in gain with temperature is also indicated in Fig. 2, the chain-dotted lines showing gains from reheating to stop-valve temperatures of 900 and 1,100 deg F whilst dotted lines illustrate improvements when reheating to 50 deg F below the initial temperature.

It may be worth summarising the advantages and disadvantages associated with the reheat cycle when comparing reheat and non-reheat turbo-generators of the same rating and for the same stop-valve steam conditions. Advantages include:—

(1) A reduction in fuel consumption of the plant of from four to five per cent with a corresponding reduction in fuel-burning equipment.

(2) A reduction of nearly half in the percentage wetness at the turbine exhaust.

(3) The total steam flow is some 15 to 17 per cent less with reheating; this leads to a reduction in size of the main steam raising equipment and in boiler feed-pump power.

(4) Though the heat content and specific volume per lb of steam to exhaust are greater with reheating, the reduced mass flow results in a 7 to 8 per cent reduction in condenser surface and cooling water requirements.

(5) A reduction in size of feed-water heating equipment.

(6) In large turbines, the long twisted exhaust blades represent considerable and expensive development, the leaving area provided by the manufacturer usually varying in relatively big steps. With a reduction of 7 to 8 per cent in the volumetric steam flow to condenser with reheating there would be either a non-thermodynamic gain in performance due to lower leaving losses or a reduction in capital cost if smaller exhaust blading could be used. Not only does reheating reduce the volume flow through the last blades, but the loss due to a given leaving velocity from the last stage, when expressed as a percentage of the available work, is smaller in the reheat cycle. For example, the percentage leaving loss for a 120 MW turbine for conditions of 1,500 lb/sq in, 1,000 deg F, reheating to 1,000 deg F, is no greater than for a 100 MW turbine with the same exhaust blading for 1,500 lb/sq in, 1,050 deg F, despite the 20 per cent greater output.

Another advantage of reheating can be the use of lower steam conditions with less costly materials so as to obtain the same thermal performance as non-reheat plant with higher steam pressures and temperatures. The 50 MW turbines at Dunston "B" station with steam at 600 lb/sq in, 850 deg F, reheating to 850 deg F, have approximately the same heat consumption per kWh as 60 MW, 900 lb/sq in, 900 deg F non-reheat units; similarly, the 60 MW reheat sets at Littlebrook "B" (1,235 lb/sq in, 825 deg F/825 deg F) have the same thermal efficiency as the 60 MW non-reheat turbine at Battersea "B," which is designed for initial conditions of 1,350 lb/sq in, 950 deg F.

Disadvantages of reheating include:—

(1) Difficulties caused by increase in complexity of operation and control though in practice these are proving less than expected.

(2) Extra cost of the reheat section of the boiler and of the turbine, which will require a larger number of stages and additional control valves. With the reduced cost of the steam raising portion of the boiler and of the condenser and feed-heating equipment, however, it is doubtful, in fact, if the overall capital outlay for a large station with reheat is appreciably, if at all, higher than for a non-reheat plant with similar stop-valve conditions and unit size of turbine.

(3) Greater floor space is necessary to accommodate the longer turbine, interceptor chests and reheat piping.

(4) The more complicated piping and valve system leads to problems in providing for the necessary flexibility at high temperatures.

(5) Turbine blading immediately after the reheater is considerably longer than in the first stage of the high-pressure cylinder and new design problems arise in keeping blade fastening and wheel stresses, due to centrifugal forces, within the high-temperature creep strength limits of available materials.

(6) The first feed heater below the reheater steam inlet (No. 5 in Fig. 1) may require to be of expensive construction due to the relatively high temperature of the bled steam unless a large feed-temperature rise across the top heater (No. 6) is tolerable.

(7) At light loads the steam through the last blades to condenser can be superheated unless the reheat temperature is reduced. As a precaution against overheating of the long exhaust blading with small steam flows some manufacturers make provision for spraying feed water into the inlets of the low-pressure cylinders under these conditions.

A major problem with reheat units is control against excessive rise in speed with sudden loss of load. Normal load variations in service can be controlled by the action of the high-pressure inlet governor valves. If load were suddenly lost, for example, should the electrical tie with the grid be broken, the inlet governor valves would shut off the live steam supply due to the consequent rise in speed, but the relatively large volume of steam still entrained in the reheater and associated piping system could expand through the turbine blading below the reheater return inlet to the condenser and cause overspeeds of up to 30 per cent or more. For this reason, additional "interceptor" governor valves are fitted at the inlet to the turbine after the reheater and are biased to close after the high-pressure inlet valves should a rise in speed exceed normal. As an additional safety measure it is common practice to fit emergency valves in series with both the inlet and interceptor governor valves; should the governor valves fail to close or a set run up to more than about 10 per cent above normal speed, the overspeed governor would trip both sets of emergency valves.

Progress since the war in the development of large sizes has led to the increasing adoption of the single boiler-turbine unit, with much improved co-operation between boiler and turbine designers. There appears to be little difference between reheat and non-reheat plant in the procedure for starting up from cold provided the firing rate in the reheat plant is controlled so that, during the steam raising period and before steam flow through the reheater is established, the gas temperature entering the reheater does not exceed that permitted at atmospheric pressure for the materials used. With the reheater positioned behind all the superheater surface, the gas temperature during rapid starts should not reach a dangerous level before steam is circulating through the reheater tubes. It is desirable that high-temperature steam be admitted to the turbine at both admission points after short shut-down periods; in some arrangements the boiler is artificially loaded through by-passes and desuperheaters, steam being passed through both the superheater and reheater elements and finally condensed.

The first reheating turbine plant in the world was started up in Great Britain at the North Tees power station in

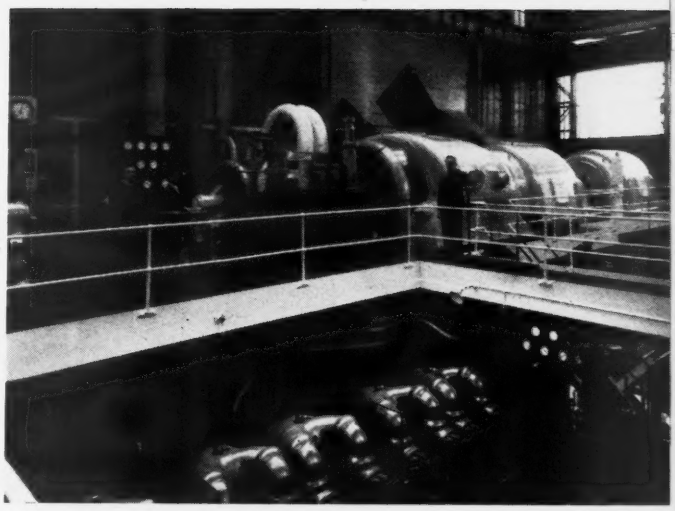
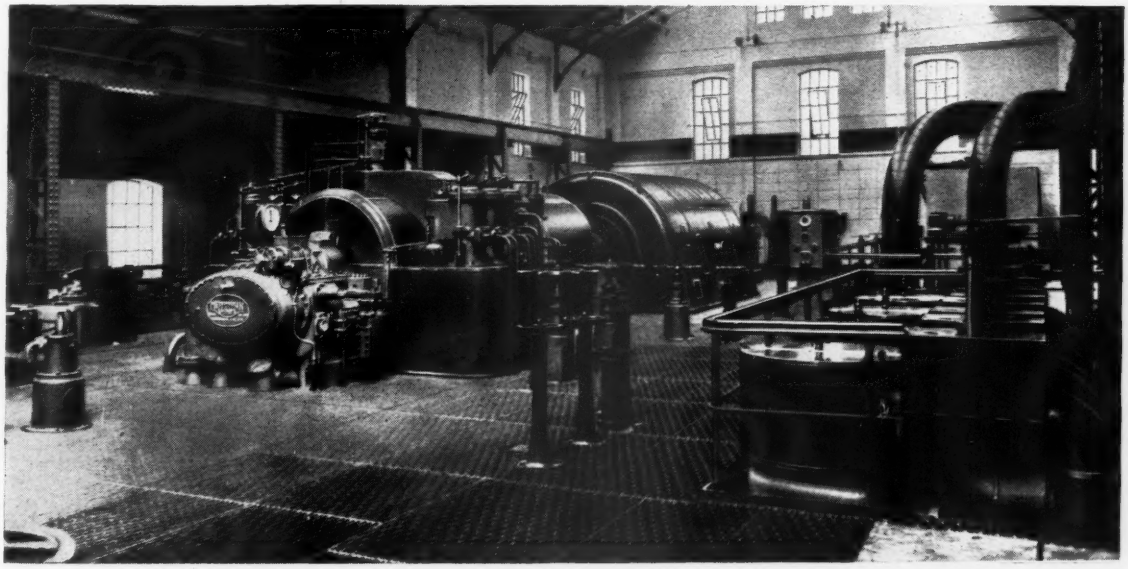


Fig. 4.—20 MW sets at North Tees power station after rebuilding for operation at 3,000 r.p.m.

Fig. 5.—Two-cylinder 3,000 r.p.m. tandem set for No. 1 axis at Brimsdown "A" power station



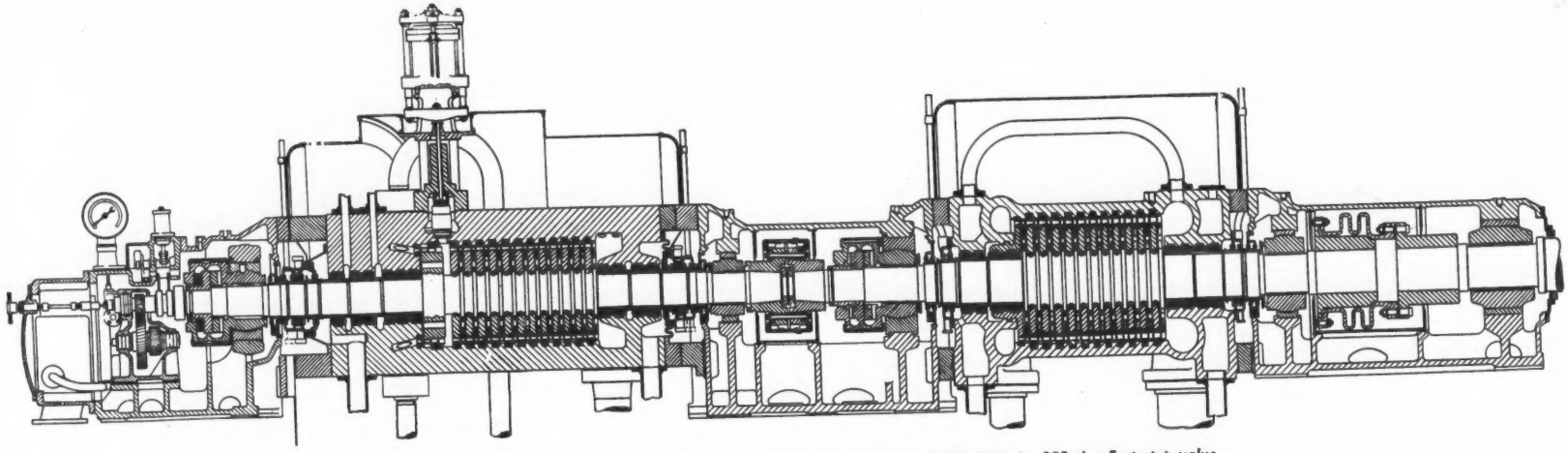


Fig. 6.—Tandem turbine for No. 1 axis at Brimsdown "B" power station—1,900 lb/sq in, 932 deg F at stop valve

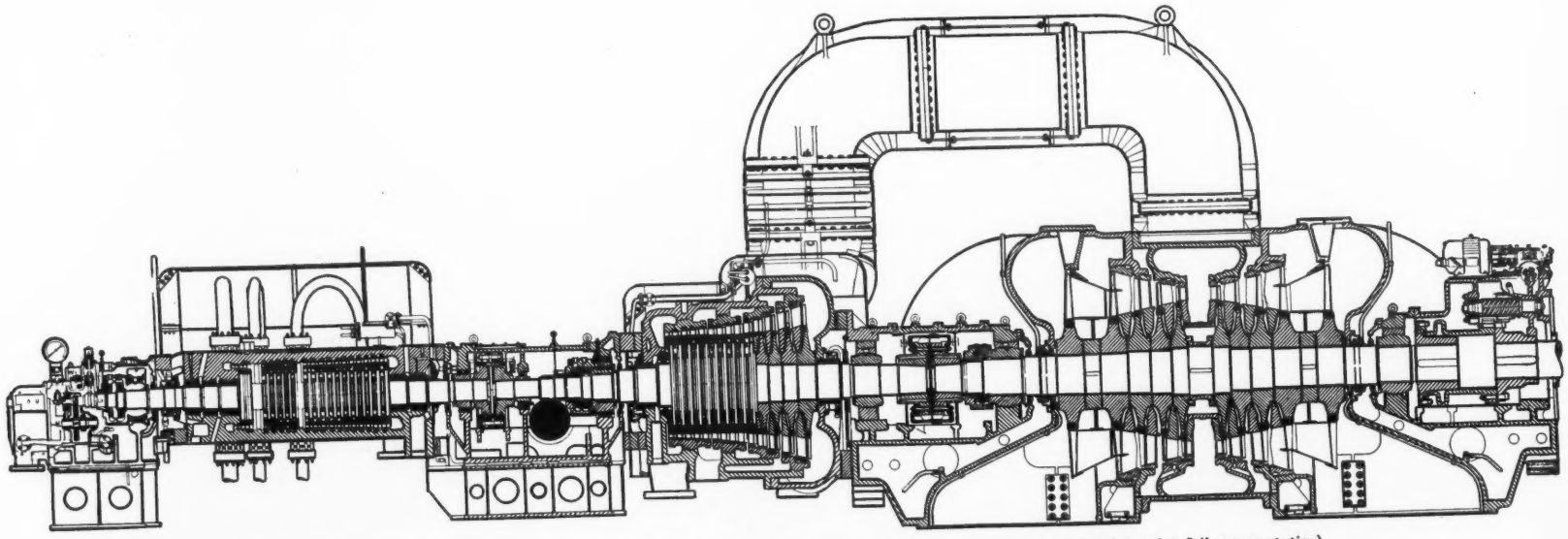


Fig. 7.—60 MW, 3,000 r.p.m. tandem-compound turbine for 1,235 lb/sq in, 825 deg F, reheating to 825 deg F (Littlebrook "B" power station)

1920. Each of the two 20 MW turbines was of the two-cylinder tandem type running at 2,400 r.p.m. and designed for the then advanced steam conditions of 450 lb/sq in, 650 deg F, with reheating to 500 deg F; multi-stage feed heating and Baumann multi-exhausts were incorporated (Fig. 3). In 1930 the turbines were rebuilt to operate at 3,000 r.p.m. (Fig. 4).

In the United States the first reheat turbine was the 40 MW unit at Philo, started in 1924, for conditions of 550 lb/sq in, 700 deg F, with reheating to 700 deg F. At the outbreak of the last war, five reheat sets were operating in this country whilst over a dozen were running abroad. During the past decade a great number of reheat turbines for power stations all over the world have been manufactured or are on order for unit ratings of from 50 to 450 MW each. On smaller plant with steam conditions below 2,000 lb/sq in, 1,050 deg F, reheating has been dictated by economic considerations such as high fuel costs; with higher pressures reheating not only improves the thermal efficiency but becomes necessary to avoid excessive exhaust wetness.

Though it is difficult to select outstanding reheat turbines it may be of interest to compare early machines with some post-war designs now on order or due to go into service and to illustrate constructional features which are being incorporated. Dagenham (30 MW, 1,200 lb/sq in, 750 deg F/550 deg F, 1930), Dunston "B" (50 MW, 600 lb/sq in, 800 deg F/800 deg F, 1933) and Brimsdown "A" (Fig. 5) are advanced pre-war designs; though commissioned in 1943, the 60 MW set at Brimsdown "B" is of a very similar design to that at the "A" station. Both units are of the two-axis type, the two-cylinder 3,000 r.p.m. primary set for inlet conditions of 1,900 lb/sq in, 932 deg F (Fig. 6) exhausting to the reheater where the steam temperature is raised to 800-850 deg F before admission to an orthodox two-cylinder 3,000 r.p.m. condensing turbine on the second axis.

The first four 50 MW reheat sets at Dunston "B" are of the two-cylinder type running at 1,500 r.p.m.; the two post-war 50 MW three-cylinder 3,000 r.p.m. units have stop-valve conditions of 600 lb/sq in, 850 deg F, with reheating to 850 deg F. Though of pre-war design,

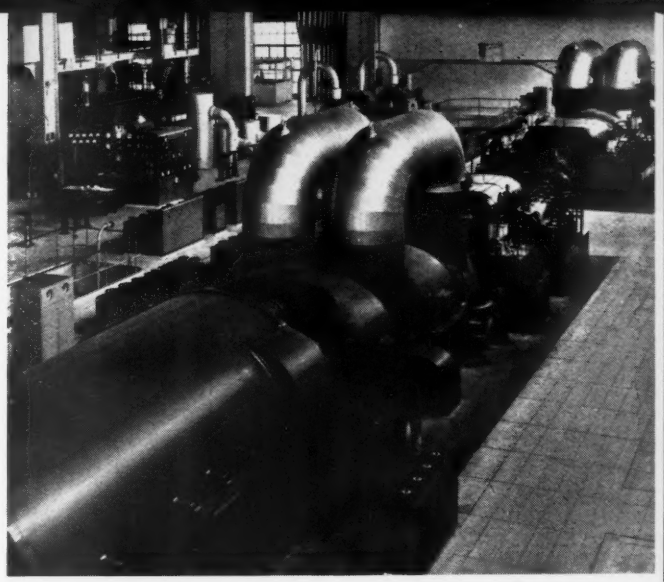


Fig. 8.—60 MW sets at Littlebrook "B" power station

the two 60 MW sets at Littlebrook "B" (Figs. 7 and 8) have an overall heat consumption which still keeps this station amongst the most efficient of the Central Electricity Authority.

After the war, to expedite power station construction in this country and reduce costs, non-reheat units with standardised steam conditions for 30, 60 and 100 MW were built and are on order. The economic advantages due to reheating, however, have led to the adoption of the 120 MW c.m.e.r. reheating set with steam at 1,500 lb/sq in, 1,000 deg F, reheating to 1,000 deg F, as an additional standard which will, in some cases, replace two 60 MW non-reheat sets (900 lb/sq in, 900 deg F) with a consequent saving of 10 per cent in fuel consumption and a major reduction in space and capital cost. Some 30 such sets are now on order for the Central Electricity Authority. Fig. 9 illustrates a modern 120 MW reheat turbine, the diagrammatic arrangement of which was shown in Fig. 1; comparison with the 60 MW machine in Fig. 7 emphasises some of the features now being introduced. The two turbines are almost identical in

Fig. 9.—120 MW, 3,000 r.p.m. tandem-compound turbine for 1,500 lb/sq in, 1,000 deg F, reheating to 1,000 deg F

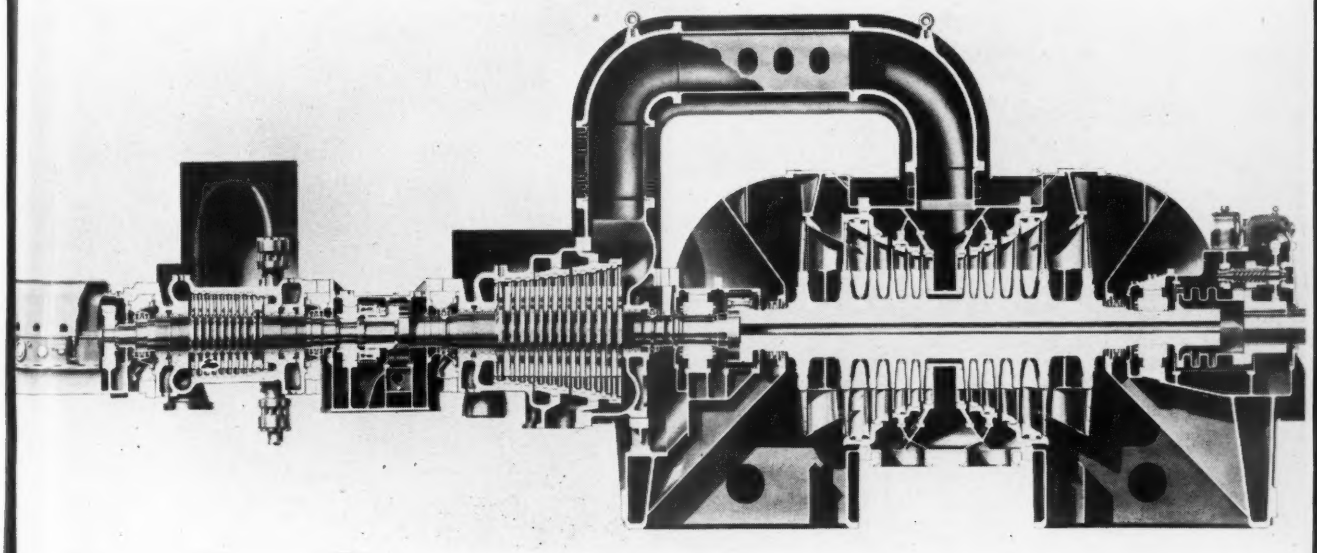


Fig. 7.—60 MW, 3,000 r.p.m. tandem-compound turbine for 1,235 lb/sq in, 825 deg F, reheating to 825 deg F (Littlebrook "B" power station)

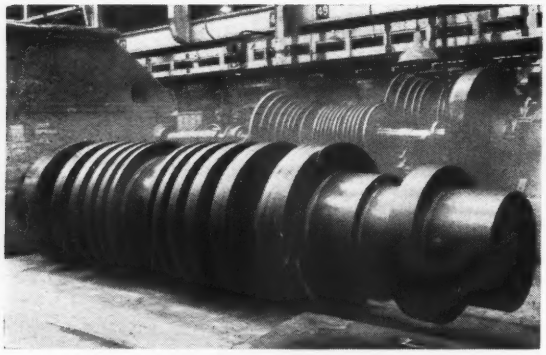


Fig. 10.—Low-pressure rotor forging for 120 MW reheat turbine

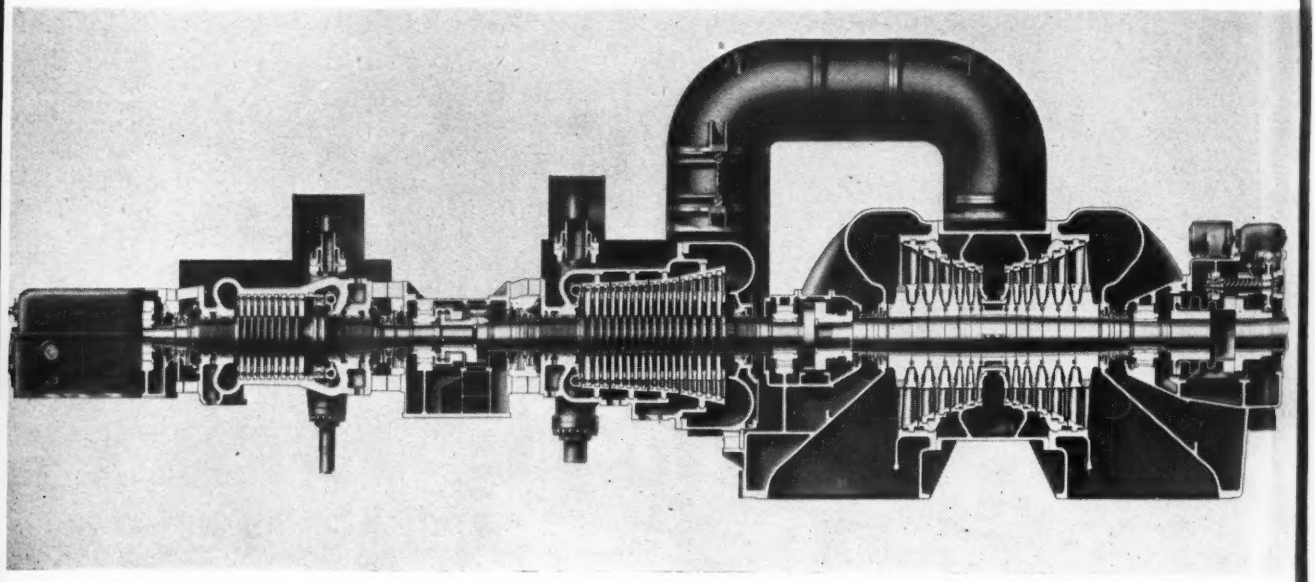
length and have similar basement depths. With increase in power output, solid instead of flexible couplings have been adopted and the three rotors are bolted together to form, in effect, a single four-bearing shaft with one thrust bearing between the high- and intermediate-pressure cylinders; mechanical losses are appreciably lower than in an arrangement with six journal and three thrust bearings. The steam flows through the high-pressure and intermediate-pressure cylinders are reversed in order to maintain axial blade clearances at the high-temperature ends of the cylinders. Steam from the exhaust end of the high-pressure cylinder at approximately 400 lb/sq in and 700 deg F is reheated to 1,000 deg F before passing through the interceptor valve chests to the intermediate-pressure cylinder inlet. Rotors subject to high temperatures are of molybdenum or molybdenum-vanadium steel and the latter material is also used for steam chests, high-temperature piping, inlet end blading, diaphragms, etc. The alloy steel forging for the low-pressure rotor is seen in Fig. 10. Though not obvious from the illustrations, much study and experimental development has since gone into turbine blade profiles; also the blades in the two exhaust flows are now designed for vortex-flow and have been increased in length and diameter to give an effective leaving area over 40 per cent greater than before.

The 50 MW turbine shown in Fig. 11 has similar steam conditions to those for which the 120 MW set referred to above was designed. To meet varying load demands " inserted " or separate nozzle boxes are fitted in the inlet end of the high-pressure cylinder providing group admission or cut-outs; separate nozzle boxes are provided in the intermediate-pressure cylinder inlet end immediately after the reheater. High-temperature steam is confined to these boxes, which are free to expand in guides independently of the cylinder barrels. Though the rating is low and inlet end blade heights small, sufficient gain from reheating justifies its adoption in this special case of a Continental customer with very high fuel costs.

The largest units at present on order for the Central Electricity Authority are for 200 MW each; with initial conditions of 2,350 lb/sq in, 1,050 deg F and reheating at 475 lb/sq in to 1,000 deg F, a fuel consumption per unit generated some 5 per cent lower than that of the standard 120 MW is anticipated. During the development of these large sets the merits of cross-compound and 3,000 r.p.m. tandem-compound arrangements required detailed comparison. Cross-compound two-axis designs fall into two general classifications; in the first category, one axis runs at a higher speed (say, 3,000 r.p.m.) and the second axis at half the speed (1,500 r.p.m.). In the second category the speeds of both axes are equal. Diagrams of some typical cross-compound arrangements are indicated in Fig. 12. Usually two axes are provided though three have been used in special cases.

Cross-compounding has several advantages; overall length per shaft is less, affording greater flexibility in station arrangement, and turbines and generators can be designed more conservatively. The higher speed (say 3,000 r.p.m.) is inherently better for the high-pressure turbine whilst with a low-pressure axis speed of, say, 1,500 r.p.m., the annulus area of the last blade can be made roughly four times that of 3,000 r.p.m. blading with similar centrifugal stresses. Such arrangements are usually more expensive than tandem-compound designs but may be

Fig. 11.—50 MW, 3,000 r.p.m. tandem-compound turbine for 1,500 lb/sq in, 1,000 deg F, reheating to 1,000 deg F



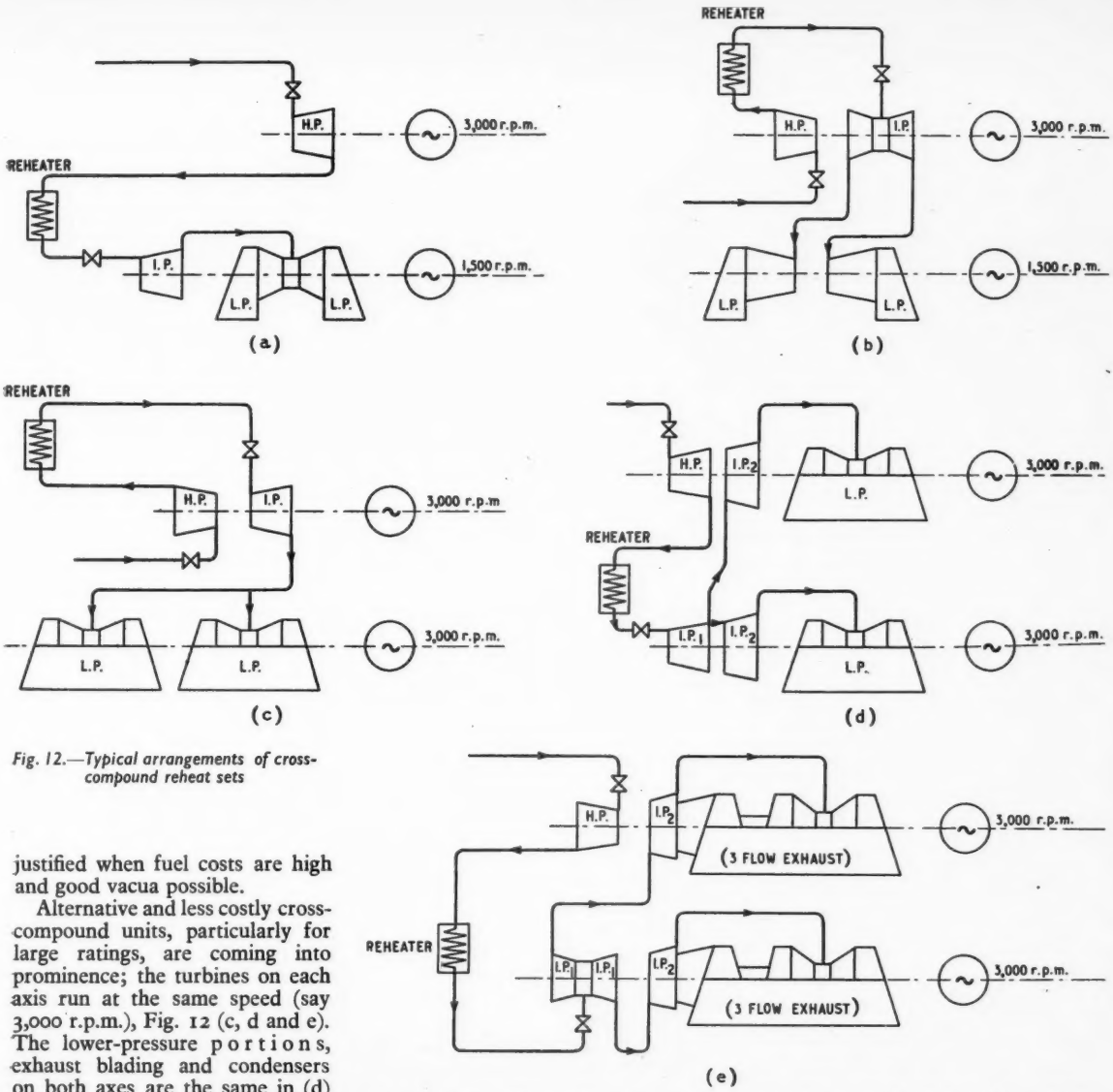


Fig. 12.—Typical arrangements of cross-compound reheat sets

justified when fuel costs are high and good vacua possible.

Alternative and less costly cross-compound units, particularly for large ratings, are coming into prominence; the turbines on each axis run at the same speed (say 3,000 r.p.m.), Fig. 12 (c, d and e). The lower-pressure portions, exhaust blading and condensers on both axes are the same in (d) and (e), equal power outputs from each axis calling for duplicate generators, simplifying design and handling problems.

At unit ratings up to 250 MW or so in this country, it appears probable that, except in special cases, the lower initial cost of the tandem machine will offset the better heat consumption provided by the cross-compound design with its greater leaving area. Certainly, in the case of the 200 MW sets, a design as illustrated in Fig. 14 will provide electricity at a lower overall cost per unit during the next twenty-five years or so than one of the two-axis type.

Features of the 200 MW tandem-compound turbine shown in Fig. 14 are of interest. The three rotors are again close-coupled with the thrust bearing placed between the first two cylinders. The first cylinder is of "double-shell" construction (Fig. 13), the pressure between the shells ensuring that the inner shell and its horizontal joint bolting are not subject to stresses which exceed the creep strength of the ferritic materials employed. The first portion of the blading immediately after the reheater is also contained in this cylinder confining high-temperature steam to one cylinder; with "internal" high-pressure gland leakage, high temperatures are kept clear of the bearings. Steam enters the remaining intermediate-pressure blading in the second cylinder at about 250 lb/sq in, 850 deg F; thus relatively high-temperature creep strength is not required in the rotor material, permitting the use of integral wheels on a chrome-molybdenum forging with lower stresses at the end which carries one of the three exhaust flows than would be possible with large shrunk-on separate wheels. Instead of being in the 1,000 deg F steam mains, the interceptor governor valves are integral with the inlet end of the second cylinder. The exhaust blades are similar to those used on the 120 MW set (Fig. 9). The condenser is of single-shell design with two nests.

Increases in size and steam conditions are projected in efforts further to reduce the overall cost of generation. Bearing and coupling problems tend to limit the output from a single shaft at 3,000 r.p.m. to about 275-300 MW; the corresponding alternator weight also reaches a limit

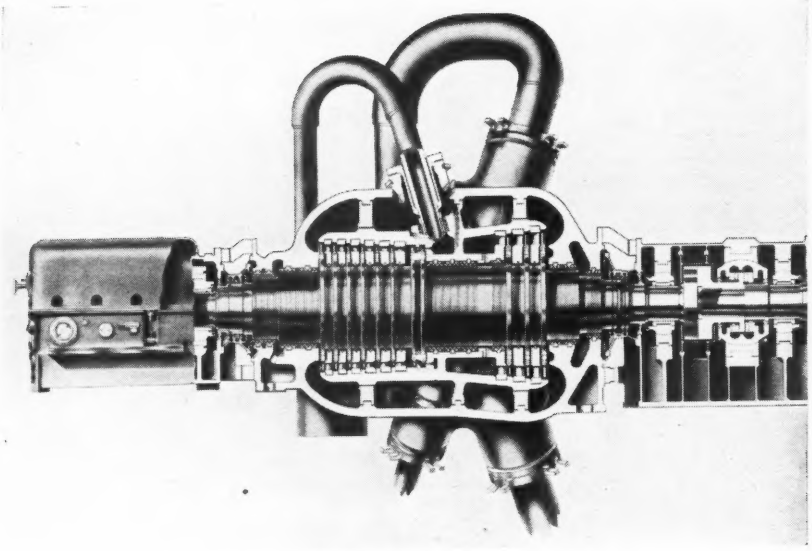


Fig. 13.—First cylinder of 200 MW reheat turbine

from a transportation aspect. Units for stop-valve steam conditions of 2,300 lb/sq in, 1,050 deg F, with reheating to 1,050 deg F, are under consideration by the Central Electricity Authority for continuous maximum and economical ratings of 275 MW from tandem-compound single-axis turbines and of 550 MW from cross-compound 3,000/3,000 r.p.m. units arranged as in Fig. 12 (e). Though the exhaust ends of both axes in the latter are each similar to the corresponding end of a 275 MW single-line set, longer blade heights in the single-flow high-pressure cylinder and proportionately smaller gland leakage losses result in a lower overall fuel consumption per unit generated. Though larger exhaust blading may permit a "blown-up" version of the 200 MW turbine (Fig. 14) to be designed for 275 MW, the increased bore of steam piping to and from the first cylinder may lead to the projected design illustrated in Fig. 15. Four cylinders are proposed, the high pressure being of double-shell design whilst separate nozzle boxes are fitted at the inlet end of the intermediate-pressure cylinder.

Tandem-compound turbines of similar designs to those illustrated in Figs. 9, 11 and 14, but running at 3,600 r.p.m., are being put forward for the North American market, with close coupling of rotors, "inserted" nozzle box or double-shell cylinder construction and triple-flow exhaust systems incorporated as standard features. Though the higher speed accentuates wheel and blade fastening stress problems, particularly at the exhaust end, fewer stages are required, resulting in a shorter machine. In regions where low cooling water temperatures are available for most of the year, the good vacua obtainable generally justify cross-compound units of either the 3,600/1,800 or 3,600/3,600 r.p.m. type for ratings above 200 MW. Steam conditions specified are usually 1,450 or 1,800 lb/sq in, 1,000 deg F, with reheating to 1,000 deg F for the 100 to 150 MW range whilst 2,350 lb/sq in, 1,050 deg F, with reheating to 1,000 or 1,050 deg F, is being adopted for higher outputs.

With boilers depending on the circulation of an excess amount of water and the separation of steam and water in a drum, superheater outlet pressures of 2,700-2,800 lb/sq in are approaching the practical limit. The difference in the densities of water and steam makes such separation possible; as pressure increases, this difference

Fig. 14.—200 MW, 3,000 r.p.m. tandem-compound turbine for 2,350 lb/sq in, 1,050 deg F, reheating to 1,000 deg F

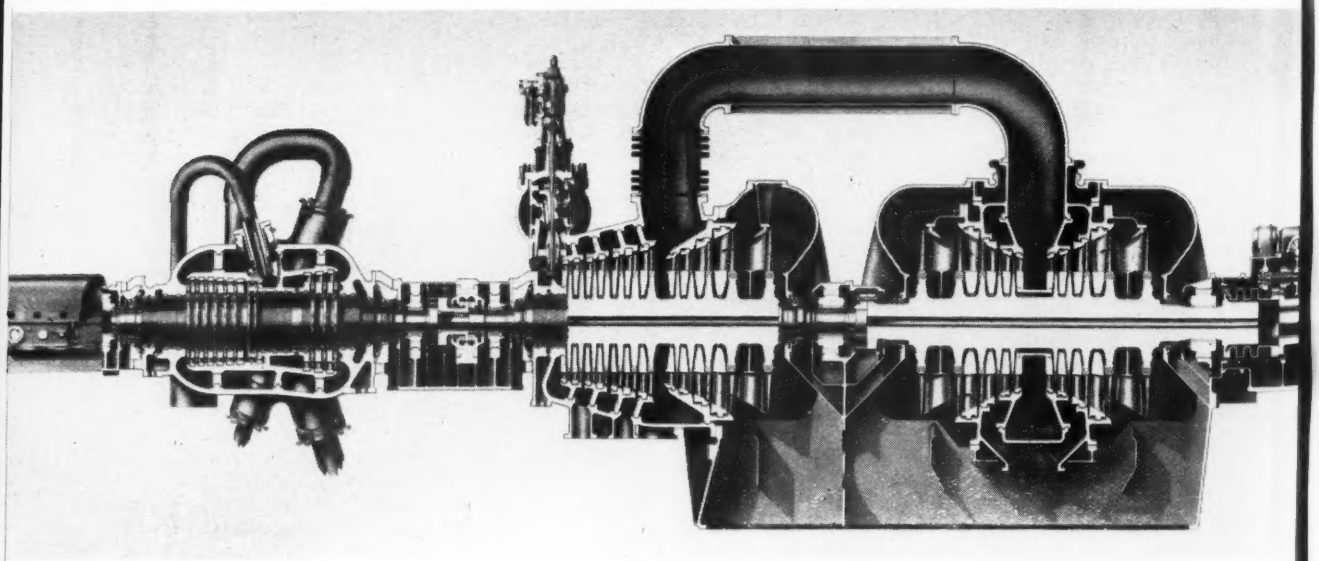
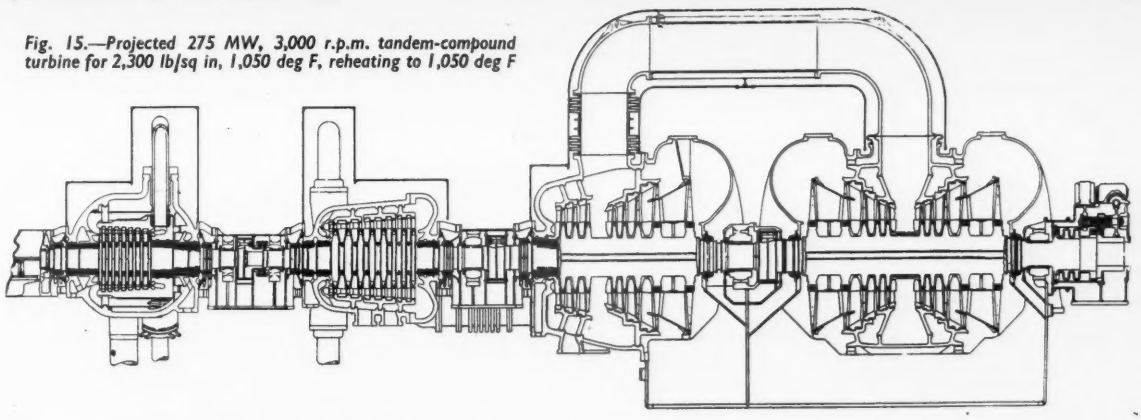


Fig. 15.—Projected 275 MW, 3,000 r.p.m. tandem-compound turbine for 2,300 lb/sq in, 1,050 deg F, reheating to 1,050 deg F



becomes progressively smaller until at the "critical" pressure and temperature of 3,206 lb/sq in, 705 deg F, steam and water weigh the same and a "once-through" type of steam generator becomes appropriate. Also it becomes impossible to concentrate impurities in the feed water by partial evaporation in a drum for removal by blowing down. Much trouble has been experienced in earlier designs of once-through or "flash" boilers due to inadequate water treatment.

The gain associated with continuous increase in pressure at temperatures possible with available materials tends to fall off as pressures in single-stage reheat plants reach the 4,000 to 5,000 lb/sq in level; even with large units, inlet end blade heights are small with relatively high gland clearance losses and special, and expensive, supercritical pressure cylinder and steam chest construction is necessary. Two stages of reheating become attractive for such high-pressure plants and the additional thermal gain of from 1 to 2 per cent justifies the extra cost in large sets.

Apart from small experimental and industrial back-pressure turbines, it is believed that the first condensing turbine for supercritical steam conditions is the double-reheat set at Philo (U.S.A.). This has the relatively small output of 125 MW, limited by existing cooling water supplies, and is of the tandem-compound type for conditions of 4,500 lb/sq in, 1,150 deg F, with reheat temperatures of 1,050 and 1,000 deg F. Now in operation the set is to be followed in 1959 by a 325 MW cross-compound unit at Eddystone (U.S.A.) for conditions of 5,000 lb/sq in, 1,150 deg F (1,200 deg F ultimate) with double reheating to 1,050 deg F. At least three further 325 to 450 MW sets are projected in the United States for operation during the next three years; stop-valve conditions of 3,500 lb/sq in, 1,050 deg F, with double reheat to 1,050 deg F in each case have been announced.

Rating of Electricity Supply Industry

CHANGES in the basis of the rates payments by the supply industry are provided for in the Local Government Bill.* The broad principle laid down in the Local Government Act of 1948 remains unchanged, namely that in place of the direct rating of the separate electricity undertakings a single payment for the benefit of local authorities is made by the Central Authority in lieu of rates. The amount of this payment is adjusted automatically from year to year for changes in the national average rate poundage and for changes in the amount of electricity sold to consumers.

Under the draft Bill, certain elements in the industry are cut out of this block arrangement as from 31st March, 1959, and are subject to direct rating valuation. These elements comprise the premises occupied by the newly created Electricity Council and any premises occupied wholly or mainly for the sale, display or demonstration of apparatus. (A similar provision is made in respect of the Gas Boards.) This liability to rates will not, however, apply to premises used mainly for the receipt of payments. Simultaneously with this change, the payment in lieu of rates under the block arrangement is reduced by the share attributable to the elements (Electricity Council and showrooms) which are directly rated.

The total payment in lieu of rates will continue to be adjusted for changes in average rates and for changes in electricity output but the share of this total which is to be borne by the individual Boards is subject to precise allocation. Previous legislation has concerned only the total amount and has left the allocation of this total to the Central Authority. The actual apportionment as between the Authority itself and the Boards has been carried out by the Authority according to a formula which takes account of both capital investment and revenue.

Under the draft Bill the apportionment is specified in detail. Of the total basic electricity rateable value in 1959/60 a share of 50 per cent is specified for the Generating Board and stated percentages (totalling 50) for each of the twelve Area Boards. Provision is made for apportioning the aggregate activities in the case of Area Boards which carry out generating operations, whilst as regards the Generating Board itself the generating and distributing activities are each taken to be one-half of the Board's basic value. In subsequent years the various percentages will be adjusted according to the output increases of the several Boards.

The overall effect is likely to be that whilst there is no substantial change in the total amount of rate payments there is some change in the incidence and considerably greater Governmental control of the detailed application. In one respect the change will be a logical corollary to the recent electricity legislation. It gives slightly less power to the Central Authority, there is more statutory and Ministerial direction, whilst the financial autonomy of the Boards—both Generating and Area—will be to some extent facilitated.

* H.M. Stationery Office, 3s 6d net.

G.E.C. Board Changes

THE General Electric Co., Ltd., has announced a number of changes and additions to the board of directors. **Mr. T. W. Heather,** M.C., Companion I.E.E., **Mr. A. L. G. Lindley,** M.I.Mech.E., and **Mr. R. E. Robinson,** M.I.E.E., have been appointed assistant managing directors, and **Mr. D. G. W. Acworth,** M.A., M.I.E.E., and **Mr. W. J. Bird** have been appointed to the board as directors.

The assistant managing directors will be responsible for the following groups:—General Products: Mr. Heather (production and home sales). Engineering: Mr. Lindley (production and sales, home and export). Telecommunications: Mr. Robinson (production and sales, home and export). Mr. Acworth will take charge of all overseas companies and export sales, and Mr. Bird will be in charge of home sales of the general products group.

Mr. Heather has been with the G.E.C. for forty-four years. He served during the 1914-18 war with the 1st Middlesex Regiment as adjutant in France and Flanders and thereafter on Divisional and Brigade Staffs. He was awarded the M.C. and Bar and mentioned in despatches. He rejoined the company in 1919 as assistant manager of the company's publicity organisation and in 1925 became personal assistant to Mr. M. Railing, who was joint managing director of the company. In 1933 he was appointed sales manager, and in 1938 he was elected to the board. He is chairman or director of a number of companies, including the M.O. Valve Co., Ltd., Salford Electrical Instruments, Ltd., and Pirelli-General Cable Works, Ltd. He has served on a number of B.S.I. and other committees in the electrical industry, and has been a member of the Electrical Fair Trading Council since 1933, being vice-chairman in 1945 and chairman since 1956. He is a past-president of the Electrical Trades' Commercial Travellers' Association. Since 1944 he has been chairman of the G.E.C. Education and Training Committee.

Mr. Lindley was appointed a director of the G.E.C. in 1953, and for the past eight years has been general manager of the company's mechanical engineering works at Erith. Born in 1902, he started his career with the G.E.C. in 1918 as an apprentice and studied at Woolwich Polytechnic. His outstanding engineering ability was soon recognised by the company and it was not very long before he had established a high reputation in the turbine and heavy engineering design departments. In 1932 he took up the position of chief engineer of the British General Electric Co. of South Africa and shortly afterwards he was appointed a director and assistant general manager. He was also appointed a director of the East Rand Engineering Co., and in this capacity he pioneered the manufacture in South Africa of heavy mining and other mechanical equipment. His work in this direction led to the expansion of these industries by the Government of South Africa who called upon Mr. Lindley to advise on the equipment and layout of new heavy engineering works.

In 1949 Mr. Lindley was recalled from South Africa to take up the appointment of general manager of the G.E.C. heavy mechanical engineering works at Erith, which he reorganised and expanded to meet the demand for the largest power generating units. When the company decided in 1954 to enter the new field of atomic energy and to develop its designs for complete atomic power stations the responsibility for its efforts in this field was placed in the hands of Mr. Lindley. He has, on several occasions, visited the United States, Canada, South Africa, Australia, India and the countries of Western Europe to discuss the development of nuclear power.

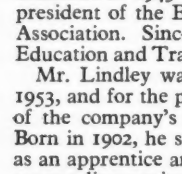
Mr. Robinson has concentrated on telecommunications work throughout his career in the electrical industry. Educated at the City of Westminster School and Finsbury Technical College, he joined the Western Electric Co. in London as an engineer in 1903 and two years later went to the Bell Telephone Co. in Antwerp as an engineer. In 1908 he became chief engineer of the Peel-Conner Telephone Works, then a subsidiary of the G.E.C., and in 1922 he was appointed sales manager of the G.E.C.'s Telephone Works at Coventry, responsible for control of all business policy. He was elected to the board of the G.E.C., as director in charge of the telephone and radio works, in 1945.

Mr. Robinson is a Fellow of the Institute of Industrial Administration, and a founder member of the British Institute of Management. He is a member of the Council and a past chairman of the Telecommunication Engineering and Manufacturing Association.

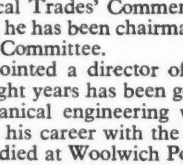
Mr. Acworth, who was educated at Radley and St. John's College, Cambridge, joined the G.E.C. in 1923. He specialised in heating and cooking, and was an original member of the Household Appliances Department of the G.E.C. when it was formed in 1926. He was appointed manager of the Domestic Cooker Department in 1933. During his managership he held office as chairman of the B.E.A.M.A. Cooker Section, in 1946 and 1947, and was a founder member of the I.E.E. Utilisation Section Committee. He also served on several B.S.I. Committees connected with heating and cooking. Mr. Acworth was appointed manager of the G.E.C.'s Export Department in 1948, and since that time he has travelled extensively overseas, visiting East and West Africa, New Zealand, Malaya, Hong Kong, and the Middle East, and paying many visits to the company's agents in Europe and elsewhere. He is a director of sixteen of the G.E.C.'s overseas subsidiaries.

Mr. Bird was appointed home sales manager of the G.E.C. at the end of November, 1956. A younger son of the late Alderman T. P. Bird, J.P., he was educated at King Edward's School, Birmingham, and joined the G.E.C. as a student apprentice at Witton Engineering Works in 1925. After some years on the engineering sales staff at Liverpool and Birmingham he was appointed manager of the Industrial Sales Department at Birmingham in 1940, and in 1942 he became assistant district manager, Midlands Area. Mr. Bird transferred to G.E.C. head office, London, in 1949 as assistant to Mr. T. W. Heather, sales director. He was appointed London sales manager the following year, and deputy sales manager of the company in 1954.

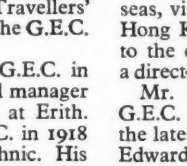
Amongst other activities he has been assistant hon. secretary of the South Midland Centre of the I.E.E., vice-president of the Birmingham Electric Club and hon. secretary and, later, deputy chairman of the Electrical Industries National Golf Championship Committee. Mr. Bird is the first ex-student apprentice of the Witton Engineering Works to be appointed a director of the company.



Mr. T. W. Heather



Mr. A. L. G. Lindley



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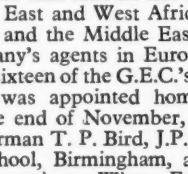
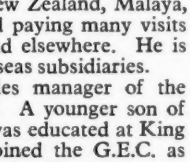


Mr. D. G. W. Acworth



Mr. W. J. Bird

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. M. J. Dark, A.M.I.E.E., is retiring from active business after forty-five years in his capacity of London director of Taylor Tunnicliff & Co., Ltd., and the associated company, Taylor Tunnicliff (Refractories), Ltd., also in the position of London manager of the Electric & Ordnance Accessories Co., Ltd.

Mr. Dark joined the staff of the Edison Swan Electric Co., Ltd., towards the close of the last century as a draughtsman; he also served in the same capacity with the British Westinghouse Co., Ltd., at Trafford Park. From 1902 until 1908 he was

Mr. M. J. Dark

Mr. H. E. Badderly

in charge of the Switchgear Department of Johnson & Phillips, Ltd., and thereafter was with the Electric & Ordnance Accessories Co., Ltd. (Vickers, Ltd.) in Birmingham until 1913 when he joined Taylor Tunnicliff & Co., Ltd., and took charge of the London office, being appointed a director very shortly afterwards. He subsequently joined the boards of Electric Transmission, Ltd., and Taylor Tunnicliff (Refractories), Ltd. Mr. Dark is retaining his directorships.

Mr. H. E. Badderly, who is to succeed Mr. Dark as London manager for Taylor Tunnicliff & Co., Ltd., Taylor Tunnicliff (Refractories), Ltd., and the Electric & Ordnance Accessories Co., Ltd., has been sales engineer for this group of companies, and assistant to Mr. Dark, since January, 1931.

Mr. A. T. Black, C.B.E., has been appointed to the board of Peto Scott Electrical Instruments, Ltd.

Mr. J. W. Field has been appointed to the board of Relay Exchanges, Ltd. He is a director of the Multi-Broadcast group of companies which have recently been acquired by Relay Exchanges.

The Simplex Electric Co., Ltd., announces the appointment of **Mr. I. Cameron** as commercial manager (distribution) operating from the company's head office at Oldbury, Birmingham. Before this appointment he had been northern area manager. This area has now been divided into north eastern and north western areas. **Mr. R. B. Heaney,** who has been with the company thirty years and until recently was "Creda" sales engineer, East Midlands area, has been appointed north eastern area manager and will be at Great George Street, Leeds. **Mr. F. W. Bell,** previously manager of the Liverpool branch, is appointed manager of the north western area. He will continue to be at Preston Street, Liverpool.

Mr. C. J. Staddon, D.F.H., A.M.I.E.E., has relinquished his appointment with McLellan & Partners to join John Miles & Partners (London), Ltd., consulting engineers, in their Electrical Engineering Department.

Last week as a part of their tour of inspection of British industry the whole of the members of the **Canadian Trade Mission** now in this country visited South Wales. They were entertained to dinner in the handsome Banqueting Hall in Cardiff Castle, the chairman on this occasion being Mr. A. J. Nicholas, O.B.E. (South Wales Switchgear, Ltd.), who is president of the Industrial Association of Wales and Monmouthshire. The delegation is headed by the Hon. Gordon Churchill, Canadian Minister of Trade and Commerce, and Mr. J. S. Duncan, chairman of the Hydro-Electric Power Commission of Ontario. We reproduce a photograph taken at the dinner.

Mr. J. C. London, whose article on "Reheat Steam Turbines" appears in this issue (p. 1011), received his technical education at Armstrong College, Durham University, and after taking his degree in mechanical engineering gained practical experience with Swan Hunter & Wigham Richardson, later serving as a sea-going engineer. He joined Metropolitan-Vickers in 1931 and was engaged successively on steam turbine blading, blowers, compressors, and fans, and the design of industrial and marine turbines. More recently he has been concerned with the development of steam turbines in general, and has paid considerable attention to the analytical investigation of steam cycles and turbine performance, some aspects of which were indicated in his paper to the Institution of Mechanical Engineers on "Improve-

Mr. J. C. London

Members of the Canadian Trade Mission at a dinner given in their honour in Cardiff Castle by Welsh industrialists

ments in Thermal Efficiencies with Single-Stage Reheating at High Steam Pressures and Temperatures." Since 1951 he has had full responsibility for steam turbine development.

Mr. L. G. Bettinson, export manager, Berry's Electric, Ltd., who has just returned from a six months' tour of the United States, drove a ranch wagon containing samples 8,260 miles through 28 States, setting up display centres in all the principal cities and visiting outlying districts. His tour took him through an Indian reservation in the Wisconsin Dells. The value of his trip is shown by the fact that during this period the value of "Magicoal" and "Berrylog" fires sent to the United States was $295,000.

As we reported in our last issue, Mr. Leslie Gamage, M.C., has been appointed chairman of Pirelli-General Cable Works, Ltd., in succession to Sir Harry Railing, and Mr. T. W. Heather, M.C., has been appointed to the board. **Mr. G. A. Baricalla** and **Mr. W. Lewis Smith** (both directors) have been appointed the Managing Committee, with the assistance of Mr. J. R. Harding, the general manager.

Mr. J. Dyer has resigned from the position of public relations officer for E.M.I. Electronics, Ltd., to join the staff of the British Electrical and Allied Manufacturers' Association as technical editor of the *B.E.A.M.A. Journal.*

The annual dinner-dance of the **I.E.E. East Midlands Centre** was held at the Welbeck Hotel, Nottingham, on 29th November. Mr. J. D. Pierce (chairman) and Mrs. Pierce received the members and their guests. The only speech was made by the chairman, who welcomed the ladies and visitors. He referred to the increasing popularity of the function and thanked the social sub-committee, under the chairmanship of Mr. D. E. Lambert, vice-chairman of the Centre, for all it had done.

Sir Herbert Barber, of Southport, stated at the recent annual dinner of the Blackpool and Fylde Branch of the **Electrical Contractors' Association** that fires of electrical origin increased from 6,000 in 1947 to 10,000 in 1956. Most of them resulted from misuse of electrical apparatus. There were hundreds of thousands of installations 25 years old. The safeguard was for the consumer to call in the electrical contractor to make a report with a view to bringing the installation up to date. There was little doubt that many fires had been caused by amateurs who did work themselves with material bought from open counters. The Home Office should obtain powers to control the sale of appliances that might be dangerous to the unskilled and place the responsibility in the hands of qualified electrical contractors.

Mr. C. T. Melling and Mrs. Melling and Mr. R. A. Jackson and Mrs. Jackson at the ladies' night of the Ipswich and District Electrical Association

Mr. R. P. Mason, commercial manager, and **Mr. C. L. Chapman,** chief development engineer, of Venner Accumulators, Ltd., left by air on 2nd December for a business conference in Rome with the Italian concessionnaires of the Andre-Yardney Co., Societa A.R.V.E. Roma. Their main purpose is to discuss the possibility of supplying Venner silver-zinc accumulators for use by the Italian Navy. In addition, talks will take place with several aircraft construction companies and industrial concerns.

The **Ipswich and District Electrical Association** held its annual ladies' night on 29th November at the Royal Hotel, Clacton-on-Sea, some 200 members and their guests being present. Mr. C. T. Melling (president) and Mrs. Melling, together with Mr. R. A. Jackson (chairman) and Mrs. Jackson, received the guests.

As a result of the recent annual dinner of the Merseyside area of the **Electrical Industries Benevolent Association,** of which Mr. W. Trace is

At the annual dinner-dance of the East Midland Centre of the Institution of Electrical Engineers held in Nottingham on Friday last. **(1)** *Mr. J. D. Pierce and Mrs. Pierce receive Mr. N. F. Marsh (deputy chairman, East Midlands Electricity Board) and* **(2)** *Mrs. Marsh, Mr. L. F. Jeffrey (divisional controller, East Midlands Division, C.E.A.), and Mrs. Jeffrey.* **(3)** *Left to right: Mr. D. E. Lambert (senior vice-chairman), Mrs. Pierce, Mr. Pierce and Mrs. Lambert.* **(4)** *Mr. J. H. R. Nixon (director, Brush Electrical Engineering Co.), Mrs. Nixon, Mr. M. Tattersfield (managing director, Brush Electrical Engineering Co.), and Mrs. Tattersfield*

At the dinner-dance of the North Lancashire Sub-Centre of the I.E.E. - The groups include Mr. H. G. Cope (chairman) and Mrs. Cope, Mr. F. R. Perry, Mr. E. H. Scholes and Mrs. Scholes; Mr. and Mrs. Cope, Mr. Perry, Mr. and Mrs. H. Diggle, and Mr. and Mrs. C. F. Tyrrell

chairman and Mr. E. G. Sellers (Selex) is secretary, it is expected to send £500 to the central fund.

The annual dinner-dance of the North Lancashire Sub-Centre of the **Institution of Electrical Engineers** was held on 30th November at the Cliffs Hotel, Blackpool, nearly 200 members and guests attending. The chairman (Mr. H. G. Cope) and Mrs. Cope, with the immediate past-chairman (Mr. E. H. Scholes) and Mrs. Scholes, received the guests. The chief guest was the chairman of the North Western Centre of the Institution, Mr. F. R. Perry, accompanied by officers of the Centre, Mr. H. Diggle, Mr. C. F. Tyrrell and their ladies. The chairman, in his address of welcome, called for a generous response to the I.E.E. Benevolent Fund. From previous functions £275 had been donated.

Mr. G. N. Green, chief engineer to the Eastern Electricity Board, who was

Mr. H. V. Pugh making the presentation to Mr. G. N. Green

recently appointed deputy chairman of the North Eastern Electricity Board, was presented with a percolator by Mr. H. V. Pugh, chairman of the Eastern Board, at the Board's headquarters at Wherstead on 29th November as a farewell gift from the staff.

The annual foremen's dinner of the **Telegraph Construction & Maintenance Co., Ltd.,** and **Submarine Cables, Ltd.,** was held at the Shakespeare Hotel, Woolwich, on 22nd November. Mr. C. Rudd, security officer, presided over a gathering of 150. Sir John Dean, chairman of Telcon, responded to the toast to the company, and Mr. F. Mattingley, general manager, Submarine Cables, Ltd., proposed the toast to the foremen, Mr. H. May, shop floor inspector, replying. Wallets of money were presented to Mr. A. Keeley and Mr. A. Churchill who retire at the end of the year and who have between them served the company for eighty-eight years. Among those present were Mr. J. Innes, C.B., and Dr. E. W. Smith, directors of Telcon, Mr. F. S. H. Lemon, managing director of Submarine Cables, Ltd., and Mr. G. W. T. Whitehead, director of Johnson & Phillips, Ltd.

OBITUARY

Mr. R. A. Archer, assistant to the commercial officer of the Essex Sub-Area of the Eastern Electricity Board, died on 24th October at the age of forty-six. Mr. Archer was educated and trained in East Ham, attending the Technical College, and then joined the County of London Electric Supply Co., Ltd., with whom he was subsequently transferred to Essex and was associated with the Romford District, now the South West Essex District of the Eastern Electricity Board. A year ago he was appointed senior assistant engineer (commercial) in the Sub-Area of Essex.

Mr. A. B. MacLean, M.A., B.Sc., M.I.E.E., who died at his home in Gosforth, Northumberland, on 25th November, joined the staff of the North-Eastern Electric Supply Co. at its head office in 1919 and remained in the Power Department until 1928 when he left to become a partner of Messrs. W. C. Mountain, Son & Wood, consulting engineers. In 1932 Mr. MacLean re-joined the North-Eastern Electric Co. and was employed in the Mines Department until the electricity supply industry was nationalised in 1948. He was then transferred to the North Eastern Electricity Board, becoming senior assistant to the head of the mining section, Chief Commercial Officer's Department—an appointment which he held until he retired a few years ago.

Mr. J. W. Atkinson.—The death occurred on 27th November at the age of seventy-nine of Mr. James William Atkinson, I.S.O., M.I.E.E., who until his retirement in 1942 was with the Post Office, which he joined as a telegraphist in Birmingham in 1893. He transferred to the Engineering Department in 1898, and in 1900 entered the Engineer-in-Chief's Office. He held a number of appointments in this Department during his career, ultimately becoming deputy regional director, North East Region. He played an active part in the establishment in 1906 of the Institution of Post Office Electrical Engineers and was secretary of the Institution from its inception until 1908. He afterwards served on the Council, was a member of the Board of Editors of the P.O.E.E. *Journal*, and hon. treasurer. His services were recognised in 1944 when he was elected an honorary member of the Institution. Mr. Atkinson had also been active in the affairs of the Institution of Electrical Engineers and he was chairman of the North Midland Centre for 1938-39.

Mr. Thomas Frederick Smeaton, A.R.T.C., F.R.I.C., wire development engineer at the British Thomson-Houston Rugby lamp works since 1952, died on 25th November at the Hospital of St. Cross, Rugby, at the age of sixty-four.

The late Mr. T. F. Smeaton

Mr. Smeaton received his training at the Royal Technical College, Glasgow (now the Royal College of Technology and Science), where he qualified in technical chemistry and became an Associate of the College. Later he proceeded to Leipzig University but at the outbreak of the First World War returned to this country.

After Army service Mr. Smeaton was a member, for a short time, of the staff of the Royal Technical College, Glasgow. In 1919 he joined the staff of the B.T.H. lamp works at Rugby as a technical chemist. In 1952 he was appointed wire development engineer, which position he held until his death. Throughout his career with the company he was engaged on the technical side of the production of tungsten and molybdenum wire and other products and was the originator of various patents.

NEW EXETER SUBSTATION

"Packaged" 33 kV Switchgear

The ten-panel "packaged" switchboard at Exeter

LAST Monday the Mayor of Exeter (Lt.-Col. R. H. Creasey) inaugurated a new 33 kV grid substation, a bulk supply point which forms part of a £54,000 scheme of the South Western Electricity Board to reinforce its supply to Exeter and district. His Worship was instructed in his duties by Mr. A. N. Irens, chairman of the South Western Board.

The substation switchgear is of "packaged" construction, devised by South Wales Switchgear, Ltd., which can be installed in the open, thus doing away with the need for the usual building and producing a more compact and less expensive job. The gear can be erected very quickly and is easily accessible, facilitating maintenance. The bulk of the assembly is done in the company's Blackwood (Mon.) factory and the substantial steel construction is such that the equipment can be moved from one site to another without loss of value. The only civil engineering work necessary is the provision of a concrete base.

The built-in control room with wall- and floor-mounted control and relay panels

The idea was developed by Mr. A. J. Nicholas, the company's managing director, after a study of gear of this kind in the United States and elsewhere. But whereas the voltage limit of the equipment has hitherto been 15 kV, by adapting its 33 kV oil circuit-breaker, with three phases in a single tank, the company has been able to produce complete substations for this voltage. The first 33 kV equipment was installed by the South Wales Electricity Board (whose chief engineer is Mr. J. W. G. Bird) and since then the company has received orders from Venezuela, Trinidad, Hong Kong, Russia, Borneo and South Africa.

An innovation in the Exeter gear is the inclusion of the control room in the structure. Later on the company intends to similarly house the low-voltage side. In the present case there are ten "panels" or cubicles, each occupying a space 6ft wide and 12ft deep; the control room is in the centre of the group and the busbars are in a separate upper compartment.

Grid Connections

The 132 kV grid supply is taken to three 30 MVA transformers connected to the packaged gear. Outgoing underground feeders serve East Devon, an overhead line goes to Okehampton and two lines feed 10 MVA transformers in the Athelstan Road substation which serves the city.

The 33 kV circuit-breakers have vertical operation and horizontal drawout. Motor-operated raising and lowering mechanism permits inspection and maintenance without removing the breakers from the units. The fixed and moving contacts of each phase of the oil circuit-breakers are segregated and the fabricated steel tank (with a silicon-aluminium alloy top plate) is lined with insulating board of high dielectric strength. The combined main and arcing contacts are of the self-aligning "rose" high-pressure line contact type mounted inside an arc-control device with resin impregnated compressed wood throat plates.

Voltage transformers are mounted at the rear of the circuit-breakers and current transformers within the circuit-breaker top plate.

The company states that the switchgear has success-

fully passed the full series of breaking tests in accordance with the appropriate B.S. Specifications and certificates are held for ratings of 500, 750 and 1,000 MVA.

Mr. Nicholas presided at a luncheon after the inaugural ceremony when the toast of " The City of Exeter " was proposed by Mr. Irens who characterised the new bulk supply point as an excellent example of co-operation between public and private enterprise. Reviewing the history of electricity supply in Exeter, he said that there were now 34,000 consumers and 1,000 were being added each year. Since 1948 the South Western Board had provided a new network for the reconstructed central area of the city and had connected 9,000 new homes. Mr. Irens also mentioned the advance made in rural electrification throughout Devon.

In responding to the toast, the Mayor of Exeter suggested that his city might be a better centre for the Board's activities than Bristol.

Mr. G. T. Garwood, manager of the Devon Sub-Area, proposed the toast " South Wales Switchgear " and spoke appreciatively of the activities of Mr. Nicholas, whom he described as a " world-ranging industrialist." Mr. Garwood referred particularly to the company's apprentice training scheme for which Mr. Nicholas had been mainly responsible.

Replying, Mr. Nicholas said that it was their aim to bring into the electrical industry the best brains and thus ensure the country's future. For this reason he welcomed the representatives of universities and technical colleges present at the luncheon. The close collaboration between the various branches of the electrical industry benefited not only this country but also the world.

INDUSTRY AND THE HOUSE

By A. M. F. PALMER, A.M.I.E.E., M.Inst.F., M.P.

THESE have been rather special weeks in Parliament for electricity supply. We have had the full-scale debate on the annual reports of the electricity and gas industries; the recommendation from the Committee on Privileges on the affair of Mr. Strauss and the London Electricity Board; also, the first report of the Select Committee on Nationalised Industries, which concerns itself mainly with the workings of the North of Scotland Hydro-Electric Board.

The Privilege Issue

Many of my friends in the electricity supply industry seem a little confused on the issue of privilege and appear to resent the Committee's finding of " guilty " as a slur on a respected undertaking without, apparently, it or its officers having now any means of redress. Let me say at once that I have no desire to pass judgment on the efficiency or otherwise of the financial method adopted by the London Board for the disposal of its waste copper and cable scrap. Mr. Strauss's criticism has been given publicity and now Mr. Randall, the former chairman of the Board, has put very clearly the other point of view in the correspondence columns of *The Times*. At root, I think the issue is the old and sore point of the Parliamentary accountability of nationalised industries. The professional administrators can call in aid the conclusions of the Herbert Committee that the best arrangement is for the Boards to be independently managed trading undertakings making their own relations with consumers and suppliers in the same way as do private companies. Parliament, on the other hand—with much public opinion behind it—tends to look on nationalised industries, especially in cases where there are dealings with the citizen in the mass, as public services subject to open democratic checks in Parliament and elsewhere.

My own view is that the second approach is likely to prevail in the long run because the public want it that way and the constitutional responsibilities of Members drive in the same direction. It would be an intolerable state of affairs for Members of Parliament if, when alleged abuses in Government Departments, the public services or elsewhere are brought to their notice by their constituents or others, in a genuine attempt to investigate the allegations they ran the risk of proceedings in the courts against them. It would mean that the ancient safeguards for the M.P. not only to act as legislator on behalf of the people but to " redress grievances," if he can, would be seen not to apply in this contemporary age of the managerial revolution. No friend of liberty would wish for that I think.

I appreciate of course that an important distinction can be drawn between proceedings in Parliament as such and the preliminary stages which to-day often include either a note to the Minister (who is the equal Parliamentary colleague of any honourable member) or a conversation with him in the lobbies. But is Parliament really just simply what goes on in the Chamber and the Committees upstairs? It is surely, in fact, the whole complex of relationships between Members of the House in the course of their duties whether these happen to be within the Palace of Westminster or elsewhere. Also, let it be remembered that almost any matter of administration of a nationalised industry can be raised on the adjournment of the House, even if a direct Parliamentary question would not pass the table. It seems, therefore, on the whole better for these industries that matters concerning their running should be raised privately by letter rather than that Members should be forced to bring their points immediately to the floor of the House. Anyhow, by the time these notes appear the House will have discussed the Report of the Select Committee of Privileges and have made up its mind whether the advice of the Judicial Committee of the Privy Council should be sought on a point of legal interpretation or otherwise.

Electricity and Gas Reports

The debate on the annual reports and statements of accounts of the electricity and gas industries took a full day of House of Commons' time. This is the first debate of this kind that we have had for three years. Mr. Reginald Maudling, the Paymaster General, returned specially from Paris to open it, with Mr. Alfred Robens leading for the Opposition. In his speech the Paymaster General gave a lot of time to the gas industry, principally I think because he felt that electricity supply had been well examined during the long Parliamentary course of

the recent Electricity Act. He pointed out that in the face of heavy competition from electricity and oil, gas had been able to show a surplus of nearly £4 million which he thought was a fair tribute to its efficiency. However, good quality coking coal was becoming scarcer and more expensive, which meant that there must be even more concentration on up-to-date means of production and distribution in the future.

In a brief reference to the effect of the Electricity Act, 1957, Mr. Maudling said that it was now largely a question of waiting to see how the reorganisation would work out in practice. Taking up a point which the writer had raised by question earlier, he stated that some new decisions had recently been made about oil and coal firing in power stations which could lead to a marked reduction in the amount of oil used. It was not possible to dispense altogether with oil since contracts, which had to be honoured, had been made with the oil companies. On the abundance of small coal, the Paymaster General said that it was a wrong assumption that there would be an embarrassing surplus of small coal for very long. The further development of new, larger coal-fired stations would soon use up the surplus. No fundamental change was to be made in the capital outlay for the nuclear power programme; it was simply a matter of readjusting the time schedule in order that the rate of expansion would be spread over a longer period.

Safety of Nuclear Power Stations

Anticipating questions which might be asked about danger from nuclear power stations, he said that the Ministry had been advised that since later stations would be operating at higher temperatures, it would not be necessary to carry out too often the Wigner release that had been the cause of the trouble at Windscale. Also, the newer stations would be working on carbon dioxide as a coolant and the cooling system would be closed and not open to the air as at Windscale. A formal code for safe operation and design of nuclear power stations was now being prepared.

Mr. Robens in his speech, following up the point about safety and nuclear power, said that there was very great public concern. The Government had a heavy responsibility. It was important that relations with local authorities and the services responsible for public safety should be settled before the stations came into operation. There must be also a properly trained, independent inspectorate for supervision. Mr. Robens criticised some of the experimental research of the gas industry; he thought that this might not necessarily be in the national interest if a properly balanced view was taken of the country's energy resources. He mentioned particularly the Gas Council's proposal to bring in liquid methane from overseas, which he called "an expensive experiment." Mr. Robens thought that the gas industry should give prior attention to the production of gas from indigenous sources.

In one of his most flamboyant attacks, Mr. Gerald Nabarro took not the slightest trouble to spare his own Ministers. He said that huge sums of money were being wasted by the electricity supply industry in capital investment which need not be the case if the load factor of the system was improved. The Conservative Government were engaged in the happy old practice of "chasing their own tails" by trying to beat the Socialists in lavish expenditure on nationalisation. He asked for an inquiry to be held to ascertain whether by administrative fusion between gas and electricity in their accountancy systems, metering and showrooms, there were not substantial economies to be derived for the "helpless consumer." In a very loud voice, he proclaimed his opinion that the Paymaster General should spend less time "running about Europe" on Common Market proposals and should instead get down to the job of bringing about economy in fuel and power. He seemed to forget that there is a Minister of Power although he remembered to say that Ministers as a whole were "most wasteful."

Afterwards things settled down to a quieter level with a series of speeches directed to the discussion of constituency and individual grievances. Mr. Sidney Silverman appealed to the Minister to look into the procedure by which the consumer was held responsible for the safe custody of a coin meter and the money contained in it. This had resulted in real hardship where meters were robbed by persons other than the householder. Mr. Hamilton, a Scottish member, made the somewhat surprising allegation that some employees were using the Electricity Boards' time to obtain private work for themselves. The Minister should give an undertaking that he would tighten up control to avoid such practices. Another Scottish member, Mr. George, thought that the Electricity Boards could hardly be condemned for a poor load factor which depended on the relative demand from homes, factories and mines. He was in favour of double industrial shift working in order to improve load factor.

Mr. Hayman talked interestingly on the problems of rural electrification in the south west, while a London member, Admiral Hughes-Hallett, again developed his contention—a reflection no doubt of his distinguished naval career—that gas and electricity were fundamentally public services above anything else; they should develop a public service approach rather than a commercial outlook. He thought also that there was a case for a degree of merger between gas and electricity.

Safeguarding Consumers' Interests

In winding up for the Opposition the writer, after a sympathetic expedition into the economics of the gas industry, argued against too wide an overlapping of the administration of the two industries on the grounds that reasonable competition was essential if a check was to be kept on true costs. Also, consumer choice would be in danger if "co-ordination" was carried through to its logical end. Other final issues mentioned on behalf of the Opposition were free collective bargaining, the choice of leaders and the importance of joint consultation at all levels.

The Parliamentary Secretary, Mr. David Renton, speaking last for the Government said that in both wage negotiations and joint consultation he was certain that the Minister and the chairmen of the Electricity Council and Generating Board would be anxious to observe strictly the 1957 Act "in letter and spirit."

Altogether I thought the debate one of the best we have held on the subject. It was particularly healthy to see Labour members increasingly critical, as an Opposition should be, of some of nationalisation's more detailed policies with, at the same time, Government Ministers—and here and there back benchers—zealous in their defence of the Boards. This shows that nationalisation as a principle has firmly taken root and that automatic party attitudes one way or the other are losing their appeal. That is all to the good.

Since I am a member of the Select Committee on Nationalised Industries, I will not comment on their report. I will content myself with recommending to those readers who have, maybe, an unnatural taste for reading Blue Books that they should obtain a copy. For the keen student of the Governmental machine there is much of interest.

Electricity Reorganisation

Responsibility for Research and Training : Regional Control of Generation

THE Electricity Council announces that, in accordance with the provisions of the Electricity Act, 1957, agreement has been reached between the Council and the Central Electricity Generating Board regarding the transfer to the Council and the Board of the assets of the Central Electricity Authority and the contracts of service of the staffs.

The Council states, *inter alia*, that since it has an overall responsibility for research in the industry, the Research Laboratory buildings at Leatherhead, Surrey, will vest in the Council. At the same time, it is realised that at the moment more than 80 per cent of the work at Leatherhead concerns the generation and transmission side of the industry, and it has, therefore, been agreed that the contracts of service of the staff at Leatherhead will vest in the Generating Board pending further consideration of the type of research to be carried out by the Council and Generating Board respectively.

It has been agreed that one of the two training centres of the Central Electricity Authority must be preserved as a residential college for the industry as a whole and, for this purpose, the centre at Horsley Towers, Surrey, will vest in the Council. The training centre at Buxton will vest in the Generating Board, but there will be reciprocal arrangements between the two bodies for certain Area Board and Electricity Council courses to be held at Buxton and for certain Generating Board courses to be held at Horsley Towers.

The Council states that apart from certain necessary alterations in membership the conciliation and consulting machineries for the industry will continue after 1st January in their present form.

Appointment of Regional Directors

The Central Electricity Generating Board announces that, upon the reorganisation of the supply industry on 1st January, it proposes to devolve more responsibility, autonomy and power to its provincial establishments. The existing Generating Divisions will continue as operational management units and they will be grouped under regional directors as follows:—(1) North Eastern and Yorkshire, (2) Midlands and East Midlands, (3) Eastern, London, and South Eastern, (4) Southern, South Western, and South Wales, (5) North West, Merseyside and North Wales.

The following appointments of regional directors, effective from 1st January, are also announced:—North Eastern and Yorkshire, Mr. P. Briggs, A.M.I.Mech.E., M.Inst.F. (controller, Yorkshire Division, C.E.A.). Midlands and East Midlands, Mr. R. L. Batley, O.B.E., A.M.I.Mech.E. (controller, Midlands Division, C.E.A.). Eastern, London and South Eastern, Mr. A. R. Cooper, M.Eng., M.I.E.E., M.Inst.F. (member of the Generating Board and a former controller, North West, Merseyside and North Wales Division, C.E.A.). Southern, South Western and South Wales, Mr. A. C. Thirtle, A.M.I.C.E., A.M.I.E.E., M.Inst.F. (controller, South Western Division, C.E.A.). North West, Merseyside and North Wales, Mr. W. C. Parker, M.I.E.E., M.Inst.F. (controller, South Eastern Division, C.E.A.). Mr. H. J. Bennett, A.M.I.E.E., is appointed controller of the London Division and deputy director of the Eastern, London and South Eastern Region.

The existing technical organisations will remain under the divisional controllers, but accountancy and some administrative functions will gradually be brought together at the regional offices. Each Region will have a Regional Executive Committee which will administer the Region within the broad policy rulings laid down by the Central Board.

The development of the industry is such as to make it impossible to secure a uniform load on the construction staffs of the eleven Divisions, or even the five proposed Regions; it is therefore planned to establish three separate "Engineering Project Offices" as follows:—(1) North (possibly at Leeds or Manchester), working for the North West, Merseyside and North Wales, North Eastern and Yorkshire areas, (2) Midlands (possibly at Birmingham or Nottingham), working for the Midlands, East Midlands and South Wales areas, (3) London, working for the London, Eastern, South Eastern, Southern and South Western areas.

The Project Offices will have flexible boundaries to enable them, when convenient, to undertake projects in adjoining areas. They will undertake construction of new stations or major extensions to existing stations and construction of the associated switching stations, and will deal with nuclear as well as conventional power stations.

Letter to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Ilgner Flywheel Equalising Sets

I HAVE read with much interest the article by Messrs. Parkin and Pearson in your issue of 22nd November, and welcome the discussion of the characteristics of various types of rolling mill drives.

The effect of heavy peak loads on the electricity supply system is receiving considerable attention at the present time, in view of possible disturbances to other consumers. Experience shows that it is necessary to limit voltage fluctuations to considerably less than 1 per cent at points on the system from which supplies are afforded to other consumers as well as to the fluctuating loads, and the cumulative effect of supplying a number of fluctuating loads from a 132 kV or 66 kV busbar has to be considered.

I cannot agree with the authors' comment that fluctuations such as those of the order of 30,000 kVA (arising from the synchronous Ward-Leonard drive) can "be absorbed in the 33 kV or 66 kV supply network where the effect can be deemed negligible." Such damped fluctuations as those shown in Fig. 6, recurring with almost full amplitude every ten seconds or so, would almost certainly be visible to other consumers supplied from a common busbar having a fault level less than 2,000 to 3,000 MVA. In order to avoid interference, supply would therefore have to be provided by separate transformation from a substantial 132 kV source, as envisaged in the concluding section of the article.

Leeds. J. D. NICHOLSON,
Chief Engineer,
Yorkshire Electricity Board.

[Owing to pressure on space other letters are unavoidably held over until next week.—Editors, *Electrical Review.*]

INDUSTRIAL NEWS

British Electrical Power Convention

It has been decided to have an exhibition in connection with the British Electrical Power Convention to be held at Brighton from 16th to 20th June next year. The British Electrical Development Association has been invited to organise the event. The president of the 1958 Convention is Sir George Nelson, Bt. (chairman of the English Electric Co., Ltd.), and the theme will be "Electricity and World Progress—Britain's Contribution."

As the exhibition will be held in the Corn Exchange, adjoining the Pavilion in which the Convention will meet, it is expected that some saving in costs may result.

As in former years a limited amount of space will be available for electrical manufacturers who are not identified with any of the participating organisations.

Intending exhibitors should apply for space as early as possible, but not later than 31st December next, to the director and secretary, E.D.A., 2, Savoy Hill, London, W.C.2.

Cable Specifications

The members of the Rubber and Thermoplastic Cable Makers' Association have announced that as from 1st January next amendments to various British Standards will come into operation and will include a change in the construction of certain cables of particular interest to users, namely, the omission of tape from vulcanised rubber insulated braided conduit cables in sizes 1/·044in to 7/·064in inclusive (Ref. Nos. 4101 and 5101), and from single-core 250 V braided and compounded dynamo flexibles in sizes 110/·0076in and 162/·0076in (Ref. No. 4301). These cables will be available for supply against orders received on and after 1st January, 1958.

Switchgear for Venezuelan Pipe Line

South Wales Switchgear, Ltd., has received a large switchgear and transformer contract for the north terminal pipe line scheme at Lake Maracaibo, Venezuela. The contract has been placed by the Shell Petroleum Co., Ltd., on behalf of Compania Shell de Venezuela. South Wales Switchgear has for some time developed and produced the outdoor package station equipment which conforms to American practice and the contract for Venezuela includes the 33 kV equipment of this type. An example of the gear is described on page 1024.

Jarrow Factory Extensions

Morganite Resistors, Ltd., who recently completed an extension to their factory on the Bede trading estate, Jarrow-on-Tyne, are to carry out another two-bay extension. Work on the scheme will commence within a few weeks.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £183 5s 0d
Fire Refined 99·70%	ton £182 0s 0d
Fire Refined 99·50%	ton £181 0s 0d
COPPER Tubes ..	lb 1s 9½d
Sheet	ton £210 5s 0d
H.C. wire and strip ..	ton £233 15s 0d
LEAD, English ..	ton £77 15s 0d
Foreign	ton £76 0s 0d
MERCURY	flask £69 0s 0d
TIN, block (English) ..	ton £730 5s 0d
ZINC, G.O.B. Foreign	ton £65 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 6d
Sheet	ton —
Wire	lb 2s 3½d
PHOSPHOR BRONZE Wire	lb 3s 6½d
PLATINUM	oz £31 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 23⅜d—23½d

Instrumentation for Atomic Reactor

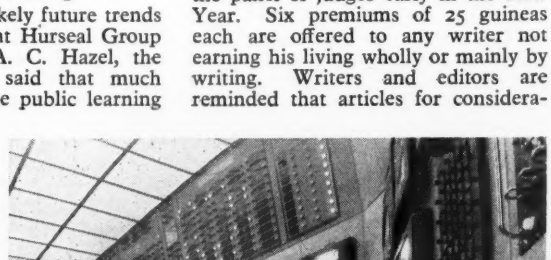
The new research reactor, "Pluto," which recently commenced operation at Harwell, is equipped with Ekco nuclear instrumentation. Ekco Electronics, Ltd., designed, installed and commissioned the complete nuclear instrumentation and control circuitry for this latest-type heavy water moderated reactor.

Future Trends in Heating

Speaking on the likely future trends in heating at a recent Hurseal Group "At Home," Mr. A. C. Hazel, the managing director, said that much would depend on the public learning to appreciate that a considerable difference existed between the heat emitted by one type of appliance and another. Heating could never be an exact science because each individual had a different interpretation of the word "comfort."

The answer lay in an appliance reducing the temperature differences across the room and ensuring an even "room-deep" warmth. The most suitable appliance was the radiator. He mentioned that his company was now making column radiators only 10⅞in high and panel radiators 11in high for use under windows with very low sills. These radiators were now available as low temperature hot-water radiators or as oil-filled electric radiators.

A colourful new folding display unit has been produced by Hurseal, Ltd., advertising its electric safety radiators. Presented in red, black, light grey and white, the display comprises a backing piece for the radiator and a pair of hinged wings which are locked in position by a long base strip. Overall length of the display is 4ft 6in, height 3ft, depth 1ft 5in. The complete unit is constructed in hardboard. A pannier for sales literature is conveniently placed at the rear.



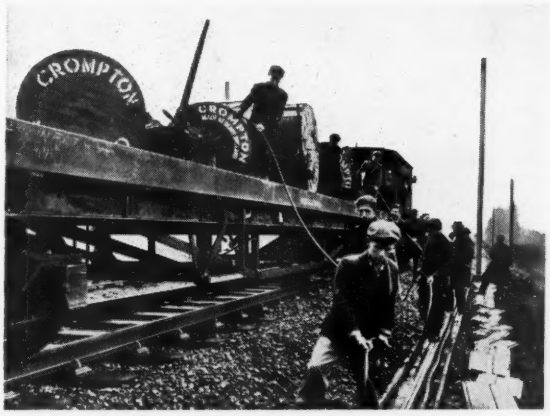
The nuclear instrumentation and control circuitry for "Pluto," the new research reactor which recently commenced operation at Harwell, designed and installed by Ekco Electronics, Ltd.

Works Managers' Report

The annual report for the silver jubilee year of the Institution of Works Managers, which ended on 30th June last, records that there was a 10·6 per cent increase in membership to 2,502. More than 300 students were enrolled during the year for the Institution's training course.

Premiums for Technical Writing

Articles on electronics published in 1957 which are eligible for premiums awarded annually by the Radio Industry Council will be considered by the panel of judges early in the New Year. Six premiums of 25 guineas each are offered to any writer not earning his living wholly or mainly by writing. Writers and editors are reminded that articles for considera-



Laying Crompton signalling cables between Wilmslow and Slade Lane Junction, part of the Crewe–Manchester line of the B.T.C.

tion should be in the hands of the secretary of the Council, 59, Russell Square, London, W.C.1, before the end of the year.

The Engineers' Guild

The annual general meeting of the Engineers' Guild is to be held at the Grosvenor Hotel, Victoria, London, S.W.1, next Wednesday. The report for the year ended 30th September last which is being presented at the meeting shows that the number of members at the close of the period was 3,608 and associates 1,011, which, with two honorary members, made a total of 4,621, a net increase of 116 during the year. The report refers to the introduction of the Guild's pensions scheme, informal consultation with the British Transport Commission on matters concerning professional grades in the Commission's service, advice and assistance given to members, public relations, etc. Full particulars are given in the report of the organisation and management of the Guild. The accounts show an excess of expenditure over receipts.

Football Ground Floodlighting

Newcastle-on-Tyne United Football Club is to spend £30,000 on the erection of 185ft high floodlighting pylons at St. James's Park football ground. The work will be carried out by Miller & Stables, Ltd., of Edinburgh.

Railway Signalling Cable

For a multi-aspect colour light signalling installation constituting part of the modernisation scheme that the British Transport Commission, London Midland Region, has in hand on the Crewe-Manchester line, Crompton Parkinson, Ltd., have supplied R/N/N type multi-core signalling cable, to a new B.T.C. specification. The installation is on the 9-mile stretch of line between Wilmslow and Slade Lane Junction, Cheshire, and provides the first instance of this cable being used in association with the 25 kV overhead electrification programme. Each core consists of a 1/·036 copper conductor, vulcanised rubber insulation (660 V grade) polychloroprene sheathed and numbered taped. The appropriate number of cores, varying in this installation by from 4 to 37 cores, are laid up with rubber fillings in the inner interstices, and a polychloroprene sheath is provided overall. The 660 V grade insulation is required for protection against the possibility of induced voltages under fault conditions in the traction circuit. The cables were run off from drums on a train of bolster wagons and laid direct in concrete ducts positioned in the "cess."

A.S.E.E. Conference

The 1958 conference of the Association of Supervising Electrical Engineers will take place at Hastings on 9th, 10th and 11th May. The conference headquarters will be the Queen's Hotel. The programme of social events will include a civic reception and dance and a motor-coach tour of the district.

"Lighting To-day" Exhibition

The latest display at the Industrial Development Centre, Paradise Street, Liverpool, of the Merseyside and North Wales Electricity Board is a "Lighting To-day" exhibition and a series of lectures, to illustrate contemporary ideas in lighting practice for the factory, the office and shop, public buildings and the home. Much prominence is given to a high temperature radiant heating installation, the first of its kind, in a Liverpool church. In each of eleven overhead lighting fittings a 6 kW infra-red heating unit has been incorporated. This provides warmth for 400 sq ft. Heat and light can be switched on separately if required. The fitting has been developed by the Board's engineers and is being manufactured by the Selex Electric Co. (Kirkby), Ltd. The G.E.C. has an interesting show which is a comparison in lighting of two model windows, one lit with tungsten lamps only and the other with blended mercury and tungsten lamps. In the architectural lighting of a room by Lumenated Ceilings, Ltd., and Atlas Lighting, Ltd., is shown an attractive decorative treatment of a ceiling in blended colours and square panels. Atlas make a big display of fluorescent lighting to an unusual geometric pattern using domino type fittings. The exhibits by Benjamin Electric, Ltd., include reflectors, floodlights, fittings for fluorescent lighting and control units. Other outstanding exhibits are those of Falk, Stadelmann & Co., Ltd., and the Walpamur Co., Ltd. Domestic electrical equipment is on view in a series of model rooms, one of which has "Thermalay," the electric carpet underlay (developed by "Manweb"), to provide floor warming. The exhibition will be continued until 13th December.

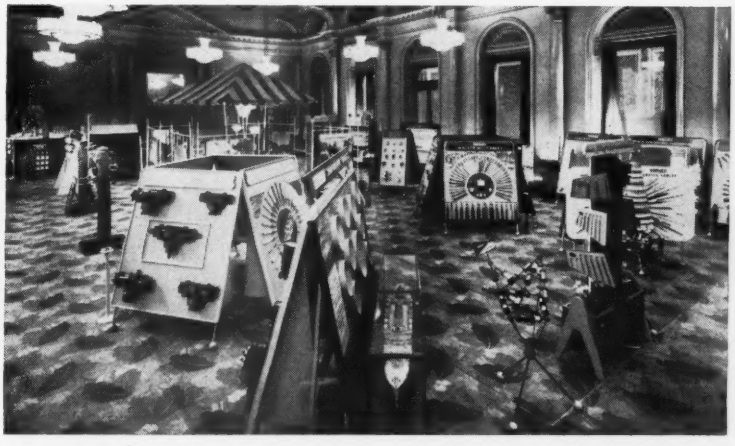
The "Ocean Layer"

The British cableship *Ocean Layer*, owned by Submarine Cables, Ltd., sailed from Greenwich on 20th November with 1,000 nautical miles of submarine cable, with which to carry out renewals to various telegraph cables in the Indian Ocean for Cable & Wireless, Ltd. The expedition is expected to last four months.

Henley Exhibition at Glasgow

A comprehensive exhibition of the manufactures of W. T. Henley's Telegraph Works Co., Ltd., was staged at the Grand Hotel, Glasgow, recently. The exhibition, which attracted a large number of visitors from all over Scot-

The exhibition of W. T. Henley's Telegraph Works Co., Ltd., held recently in Glasgow



land, provided an opportunity for electrical engineers and others to inspect the wide range of cables and distribution equipment manufactured by the company. The latest type of concentric oil-filled cable for railway electrification was on view and prominence was given to the cables manufactured by Henley's for ship-wiring work. Distribution equipment included fuses, terminal boxes, service and joint boxes, and pillars and panels.

Southern Areas Electric Corporation Acquisition

The Southern Areas Electric Corporation announces the acquisition of the whole of the share capital of Designs & Installations, Ltd. Lord Gridley, chairman, and Mr. J. W. C. Milligan, managing director, of Southern Areas, and Mr. S. R. Elliott, managing director of P.A.M., Ltd., a subsidiary of Southern Areas, join the new board of Designs & Installations, which will retain its identity and be jointly administered with P.A.M., Ltd. Mr. J. A. Hinds and Mr. C. E. Trodd, until now owners of Designs & Installations, join the P.A.M. board. The company has a factory at Guildford as well as a contract design and drawing office at 28-30, Great Peter Street, S.W.1, where designers are engaged on the solution of handling problems connected with nuclear reactors. A variety of labour-saving machines has been developed for the consumer goods industries, including machines for wrapping gas-filled tubes.

Brighton Christmas Illuminations

An illuminations scheme employing 5,000 "Osram" coloured lamps is helping to bring the festive spirit of Christmas to Brighton where, in Western Road, East Street and Castle Square, specially designed decorative fittings have been suspended at intervals across the roadway. The scheme, promoted by the Brighton Western Traders' Association with the assistance of Brighton Corporation, has been planned and supplied by the General Electric Co., Ltd., and installed by A. Geall, Ltd., of Hove; it involves the use of about three miles of wiring. The scheme was inaugurated on 18th November by the Mayor of Brighton, Alderman Charles Tyson.

Each of the decorative features is composed of a metal arch, almost two-thirds of the width of the roadway. The design of the arch apex simulates a coronet, and the arches carry coloured lamps which continue in a line on to the swags which connect the arches to the adjacent buildings. Silver plastic stars and banners are hung alternately from the centre below the coronets and the banners carry the dolphin and martlet emblems of the Brighton coat-of-arms.

Christmas illuminations in Brighton

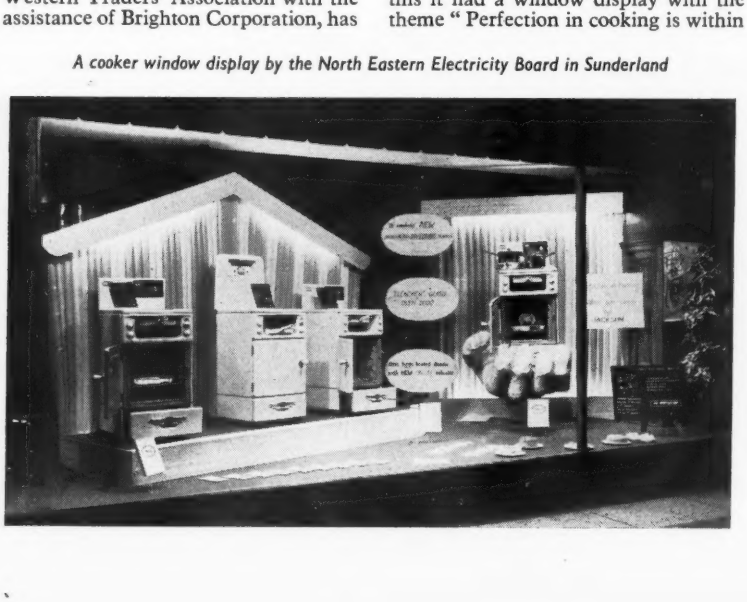
Combined Heat-Power Reactors

It is reported from Stockholm that the Asea Company's atomic energy division is at present investigating the possibilities of developing a medium temperature reactor. Additional heat obtained through the burning of oil should make the plant suitable for both thermal and power-producing purposes, it is claimed. Asea is also interested in building a minor thermal plant using enriched uranium and with a capacity of 35-40 MW.

Cooker Display

A week's special demonstrations of electric cooking was held recently by the North Eastern Electricity Board in Sunderland, and in conjunction with this it had a window display with the theme "Perfection in cooking is within your grasp." This showed a cooker supported by a massive hand. Special cooking demonstrations were given daily by Miss E. Witham, of the Jackson Electric Stove Co., Ltd.

A cooker window display by the North Eastern Electricity Board in Sunderland



New Electronics Factory

Work has started on the first stage of the £1¼ million 5-year expansion plan of the Solartron Electronic Group, Ltd., for increasing its production capacity, at Tower Hill, Farnborough, Hants. The first section of the final building of 350,000 sq ft will be ready for occupation by August, 1958, and have an area of 50,000 sq ft. The new building will house comprehensive manufacturing facilities in the fields of electronics, electro-mechanics, hydraulics, pneumatic and precision mechanical engineering. The first products will include radar simulators for NATO, the Solartron electronic reading automatons (ERA), industrial control equipment to facilitate automation and units for building flexible analogue computers and simulators for atomic reactor design.

Metway Overseas Trade

During the past year there has been a considerable expansion of the export trade of Metway Electrical Industries, Ltd., and with a view to further increasing its trade overseas, the company has appointed new agents in Pakistan, New Zealand, South Africa, Rhodesia and Nyasaland, Spain, Greece, Canada and Libya.

Fuel Efficiency in the Metal Industries

The Metallurgical Engineering Committee of the Institute of Metals is arranging an all-day informal discussion on "Fuel Efficiency in the Melting and Thermal Treatment of Metals," to be held at the College of Technology, Birmingham, on 26th February.

Works Visit

Three members of the Chinese Economic and Technical Mission to Britain visited Birlec, Ltd., Birmingham, recently. They were Dr. Chiu

Yu-chih (deputy director, Iron and Steel Industry Research Institute, Chinese Ministry of Metallurgical Industry), Mr. Pan Chi-ching (chief engineer, Rolling Mill Division of the Institute) and Mr. Cheng Chuan-hui (deputy chief, Planning Division, Chinese Ministry of Electrical Equipment Industry). Mr. J. H. Crossley, sales director of Birlec, spoke of the possibilities of trade with China now that embargoes on trade had been relaxed.

Trade Union Membership

The report of the Chief Registrar of Friendly Societies for 1956, Part 4—Trade Unions (H.M. Stationery Office, 2s 6d), shows that the membership of the Electrical Trades Union at 31st December last was 228,000 (including 13,000 females); this represented a 2 per cent increase during the year. The E.T.U. is the eighth largest union judged by membership. The second largest is the Amalgamated Engineering Union which, at 31st December, 1956, had 962,000 members (including 61,000 females)—an increase of 0·9 per cent during the year.

Commercial Travellers' Benevolent Institution

The Annual Court of Governors of the Commercial Travellers' Benevolent Institution will be held at the Berners Hotel, Berners Street, London, W.1, on 28th December (12 noon), when all standing candidates will be recommended by the Board for election without ballot.

Transformers for Skelton Grange

The British Thomson-Houston Co., Ltd., Rugby, has been awarded a contract by the C.E.A., Yorkshire Division, for two 180 MVA, 275/132 kV autotransformers for installation at Skelton Grange. This is one of the first two contracts to be placed for transformers of this rating. The units will be banked on the 275 kV side with two B.T.H. 120 MVA transformers previously supplied.

Twenty-Five Years of Diesel Locomotives

Davey, Paxman & Co., Ltd., have issued a well-illustrated publication in which they review some of the interesting diesel locomotives in various parts of the world with which they have been associated over the last twenty-five years.

Calendars

The calendar of Courtney, Pope (Electrical), Ltd., has a colourful reproduction of Worcester Cathedral, seen from the River Severn, from the painting by George Ayling, S.M.A.

A Scottish scene near Loch Laggan has been chosen by Mavor & Coulson, Ltd., for their calendar for 1958, which has large monthly sheets.

Lathkill Dale, near Bakewell, has been selected by the D.P. Battery Co., Ltd., for the picture which adorns its 1958 calendar.

Trade Announcements

Mr. A. W. Pengelly has joined the **Engineering & Lighting Equipment Co., Ltd.,** as its representative in North Wales and part of the M.A.N.W.E.B. area around Liverpool and extending as far as Southport.

Mr. E. H. Carter has joined the Ferguson Division of **Thorn Electrical Industries, Ltd.,** as sales representative for the North Wales, Cheshire, North and Mid-Staffordshire and Shropshire area. He was previously with F. K. Smith, Ltd., of Liverpool, and the R.G.D. Co., Ltd., of Romford.

The **London Electric Wire Co. & Smiths, Ltd.,** and their associated companies, Frederick Smith & Co., the Liverpool Electric Cable Co., Ltd., and the Vactite Wire Co., Ltd., announce the appointment of Mr. S. W. Hamlyn as resident representative in the East Anglia area. Mr. Hamlyn previously represented the Benjamin Electric, Ltd., in the same territory.

The Engineering Department of **Hoover, Ltd.,** at Perivale, Middlesex, has recently been almost doubled in size and now occupies some 25,000 sq ft. In addition there are further laboratories in the company's other factories at Merthyr Tydfil, Cambuslang and High Wycombe totalling 5,000 sq ft.

Besson & Robinson, Ltd., have come to an exclusive arrangement with Siemens & Halske to market, and later manufacture, their new types of miniature relays in the United Kingdom.

Erma, Ltd., has moved to new premises at Mount Pleasant, Alperton, Wembley, Middx., which will provide greater office and works accommodation.

New A.E.I. Headquarters

The imposing new headquarters of Associated Electrical Industries, Ltd., now gradually nearing completion at 25-35, Grosvenor Place, will provide London with another landmark in modern architecture. The building was originally planned before the war by the former electricity undertaking to serve as its headquarters. When the undertaking was nationalised the land was bought by the A.E.I., the accommodation at Crown House being insufficient to meet the rapid growth of the company since the war. It was also considered to be an added advantage to house the London offices of the principal A.E.I. companies in one building.

Many new ideas have been incorporated in the design of the building, including electric floor heating. The surface of the floors is of articulated hardwood squares.

Practically all the electrical work is being done by A.E.I. companies—Metropolitan-Vickers, British Thomson-Houston, Siemens Edison Swan, Ferguson Pailin, Hotpoint and A.E.I. Lamp & Lighting have all contributed equipment. Siemens Edison Swan are installing an automatic private telephone exchange, which also enables callers to dial outside numbers direct.

Owing to the heavy traffic in Grosvenor Place the offices on this frontage will have sealed double windows and be artificially ventilated. Many of the offices will be divided by movable steel partitions, thus permitting flexibility in the use of the extensive floor space.

Facilities for the staff include two staff luncheon rooms, sun terraces, a shop for cigarettes and confectionery, a barber's shop and a subterranean garage which will provide parking facilities for sixty cars. In the sub-basement there is also a fully equipped wide-screen cinema, seating seventy-six.

The second of the six floors houses the chief executives of A.E.I. and the boardrooms. Lord Chandos's room is to be panelled in painted wood, and has a balcony.

The architects, Wimperis, Simpson & Fyffe, with the help of Sir Albert Richardson, have considerably improved on the original elevation. Maurice Lambert, the sculptor, has been working for some months on the bas-reliefs that will add dignity to the main entrance.

The new headquarters of Associated Electrical Industries in Grosvenor Place, London, S.W.1

VIEWS on the NEWS

By REFLECTOR

MY quotation a week or two ago of some remarks by the Minister of Power has brought a letter from Mr. J. E. Jones, organising secretary of "Plaid Cymru." Lord Mills, referring to a demand for a separate Electricity Board for Wales, said, *inter alia*, that there were no interconnections over the mountainous areas between the north and south of the country. Mr. Jones says that this has no bearing on administration and refers to a booklet on the subject published by Plaid Cymru which quotes as a parallel case the proposed interconnection of France and England. He goes on to say:—

> "North Wales suffers from being tied to Merseyside; the best economic area for electricity distribution is not the large city but small towns fairly close together as we have in the North Wales coastal strip."

That, of course, is a matter of opinion—and of proper balance.

* * *

Discussing a new pipeline to convey oil gas from Shellhaven to the Romford gasworks, *The Times* said:—

> "Until recently the gas industry has not only suffered from the greater glamour of electricity, and of nuclear methods of generating it, but from a lack of coherent development."

But, leaving aside the possible incoherency of development, surely it is not only the "glamour" of electricity which is affecting the gas industry. In any event electricity is not so glamorous as it used to be; it is now accepted, in quite a prosaic way, as the natural agent for a good many applications.

* * *

An excellent eulogy of electricity appeared in a "Health Supplement" recently published by the *Wrexham Leader*, but something evidently went wrong in the following paragraph:—

> "Electric refrigeration enables food smoke, smell or dust, and as it needs no flue, can be placed anywhere. Control is instant and easy, a room can be quickly warmed up, and by means of a thermostat can to be stored under ideal conditions at all times and eliminates all danger of bad food being served and money wasted."

* * *

Among the London Electricity Board's consumers are the trio of ships moored off the Victoria Embankment, the *President, Chrysanthemum* and *Discovery*, which are the headquarters of the London Division of the Royal Naval Volunteer Reserve. A number of the employees of the Board and the London Division of the C.E.A. are members of the R.N.V.R., and one of them Commander R. C. R. Brooke (manager of the Board's East End District) contributes an article on the Reserve to the latest issue of *London Electricity*. Cdr. Brooke says that the ships have been stripped of their propulsion and auxiliary machinery and so are dependent on the London Board for their supply of electricity for lighting, heating and cooking, as well as for operating the radar and other training equipment. As there is a difference of 20ft between high and low water, the ship-shore connection has to be very flexible. It takes the form of tough rubber cables connected to main fuses and metering equipment in a teak cupboard against the parapet wall; the supply to the other side comes by way of cables in a pipe subway on the Embankment. In the *President* and *Chrysanthemum* the supply is converted by glass-bulb rectifiers to 220 V d.c.; the *Discovery* employs a.c.

* * *

Electron, the journal of the Electrical Trades Union says:—

> "Investigations into conditions on the Pontefract housing site revealed violations of the Contracting Agreement. The contractor was unco-operative, so we reported him to the Pontefract Corporation for a breach of the fair contracts clause. Following investigations . . . the Council decided that the contractor should be debarred for all time from submitting future tenders, and this decision will also affect contracts with other local authorities."

It seems to me that however recalcitrant the contractor may have been, to debar him "for all time" was a trifle high handed.

* * *

A somewhat superior attitude towards its humbler clients seems to have been shown by the electricity supply industry fifty years ago. In an I.E.E. paper quoted in the *Electrical Review* of 6th December, 1907, dealing with the subject of prepayment meters, it was said:—

> "First, it must be seen that no lights are allowed in rooms that are not continuously in use all the year round. Such rooms as the bathroom, spare bedroom or scullery should never have a light allowed in them on the prepayment supply system. The capital cost of the work should be kept down as much as ever possible by running the wires with the utmost economy, and the cut-outs and meters should be put in at the nearest point of the house to the mains. It must be remembered that prepayment should only be allowed for cottages and artisans' dwellings, and their wishes must be subservient almost entirely to the convenience of the supply authority. This class of people does not seriously object to have the meter, etc., in its front parlour, if necessary, and have no æsthetic scruples concerning casing being run on the ceilings. This considerably simplifies the question as to where to bring the service into the house, and how to distribute the lights. The supply authority should do everything possible to induce tenants to keep on using the light: there is a tendency among the class considered, after the first few months, during which time the novelty of the system gets worn off, to revert to oil or candles."

Designing Large Power Transformers

The Application of Digital Computers

By W. A. SHARPLEY and J. V. OLDFIELD, B.Sc.(Eng.), A.C.G.I.

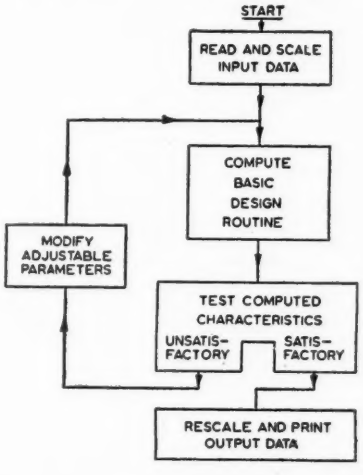
Summary by the authors of a paper "The Digital Computer Applied to the Design of Large Power Transformers" read before the Supply Section of the Institution of Electrical Engineers on 28th November. Mr. Sharpley is with Bruce Peebles and Co., Ltd., and Mr. Oldfield at Queen Mary College, London University.

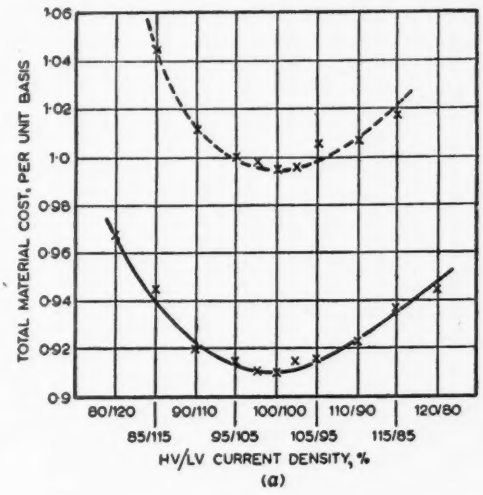
ONE of the earliest applications of digital computers was to the numerical solution of extremely involved mathematical equations, a task which by hand would have required a prohibitive amount of time. Attempts to design electrical apparatus with the aid of a computer have been made only comparatively recently. The problems involved in this later application not only possess a mathematical complexity which may equal that solved in earlier work but they also require for their solution the ability to select the correct course to be followed when, at some stage in the design, there is a choice of many possible paths.

The modern electronic digital computer is admirably suited to deal with problems of this type by virtue of the discriminatory facilities included in its order code. This code, in general, contains orders which when obeyed by the computer cause one of the four fundamental operations of arithmetic—addition, subtraction, multiplication or division—to be performed. To instruct the computer to carry out the required calculations, it is necessary to reduce the mathematical and logical steps to a series of coded instructions termed a *programme*.

A programme has been written for the design of three-phase power transformers in the range 30 to 120 MVA with voltages up to 300 kV. Once the programme and initial data have been placed in the computer, it is unnecessary for the designer to intervene as alternative design arrangements are tried automatically if any design does not meet the requirements imposed by the specification. A simplified flow diagram of the system is shown in Fig. 1. When the computer has produced a design to meet the specification originally supplied, it prints the design sheet. If, however, any computed design has unsatisfactory characteristics (iron loss, load loss and reactance), the adjustable parameters (core diameter, winding current densities and core flux density) are auto-

Fig. 1.—Simplified flow diagram for programme





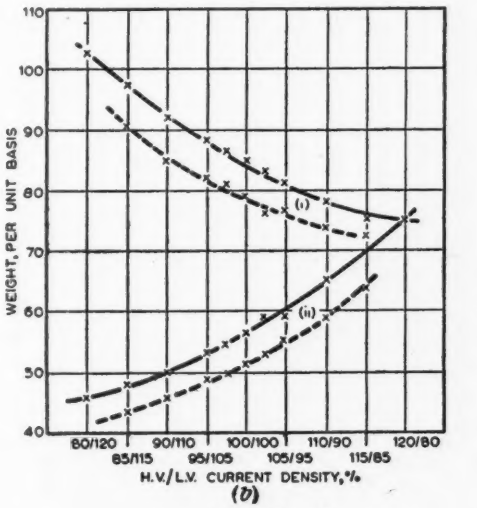


Fig. 2.—Variation of material cost and winding weights with current-density ratio; 72 MVA transformer

matically modified to cause the characteristics to converge to the values desired.

The modification scheme, which is a most important part of the programme, is based on a set of approximate relations between the adjustable parameters and the characteristics; the relations are on a per-unit basis and are reasonably constant for the range of designs covered by the programme. The scheme has been shown to be effective both by the calculation of a large number of routine designs with few iterations per design, and also by a specially devised set of tests in which the initial values of the adjustable parameters were systematically varied over quite wide ranges.

The programme has been very useful in investigating overall optimisation of designs. The studies, which are principally concerned with minimising cost, would have taken a prohibitive amount of time by hand computation, but the availability of a computer reduced the time to the order of minutes.

The first study was concerned with the effect of varying the ratio of the current densities in the h.v. and l.v. windings of a 72 MVA transformer; the specified iron loss, load loss and reactance were maintained within ± 1 per cent. The results are shown in Fig. 2 with curves for both hot-rolled and cold-reduced steel cores. It is quite clearly shown that, for this size of transformer, minimum material cost is achieved when the current densities are nearly equal; the type of core material does not seem to influence this result.

Another study considered the effect of varying the window height of a 144 MVA transformer; each of the seven designs computed met the specified iron loss, load loss and reactance within ± 2 per cent. The results given in Fig. 3, show that as the window height increases the cost initially falls to be followed by a sharp rise. The total weight changes more gradually, and also passes through a minimum, although not at the same window height as the cost. This illustrates the difficulty of using the active material most economically when the choice of design is restricted by severe weight limitations. The following table shows the computer time required for this investigation:—

	min sec
Input of programme tape	3 37
Input of first set of data	— 16
Input of six sets of changes to data	— 12
Nineteen iterations through the basic design routine ...	8 33
Punching of seven sets of output data	4 5
(the results are printed away from the computer) ...	
Total time required	16 43

All the programme and data are punched on standard teleprinter tape. Although the computer performs arithmetic in a scale-of-2 (binary) rather than a scale-of-10 (decimal), this does not inconvenience the designer, since number conversions are carried out by the computer. All numbers supplied to the computer and obtained from it are in the decimal form normally used by the designer.

The present programme has already proved its value, both in routine design and in the development of designs for new ranges of transformers, with economy of time and effort. It is anticipated that further development will lead to considerable changes in design office procedure, and will enable designers to devote a greater proportion of their time to the numerous problems urgently requiring solution.

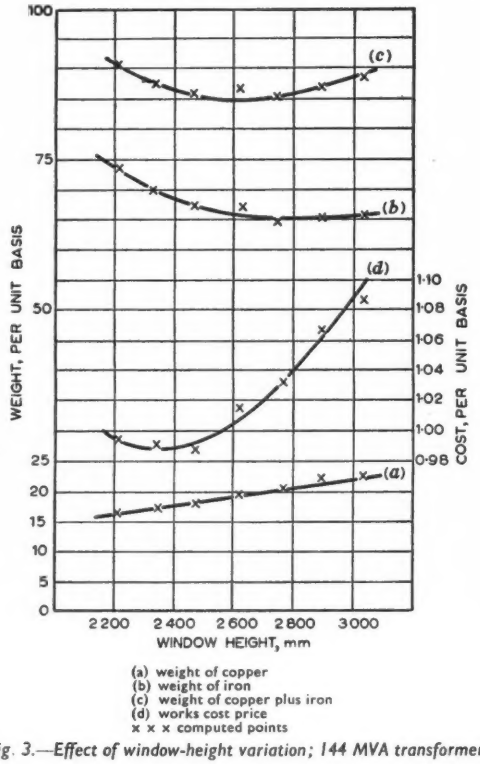


Fig. 3.—Effect of window-height variation; 144 MVA transformer

Discussion

Mr. H. M. Lacey (Electrical Research Association), who opened the discussion, deprecated the use of such expressions as " mechanical brain " or " electronic brain." The digital computer served a very useful purpose, but could only give out what had previously been put in. The transformer designer, on the other hand, could do a number of things the computer could not do. For instance, the computer could not distinguish between correct and incorrect information. What it gained in speed it might partly lose in lack of discrimination. It was an immense advantage to be able to ascertain in a few minutes the effect of varying a parameter, but the machine in no way replaced the skilled designer. Reference was made in the paper to " weeks of laborious calculation " but in twenty-seven years he could recall no such efforts and he doubted whether designers had radically changed. The good designer saved himself most of the labour by making a good first guess.

Mr. E. T. Norris would not even allow that a computer was an aid to design: the two things were entirely different. Design was the choice of suitable materials and stresses and the rest of the work was purely numerical, needing merely a knowledge of arithmetic. However, the computer was a wonderful help to a designer and the greatest contribution to the design office since the invention of the slide-rule.

Professor M. W. Humphrey Davies (Queen Mary College) said that to him the most important point was that once the designer had worked out the principles, the computer provided him with a perfect assistant designer who never made mistakes. It was not used just for arithmetic but also to make logical decisions. It was tireless in trying different combinations until it found the best.

Mr. G. N. Leech (British Thomson-Houston Co.) welcomed the digital computer as a likely device for saving manufacturers from a very difficult manpower situation. Young men of to-day were more interested

in electronics than in humdrum transformer design operations, and electronic computers were enabling transformers to be designed by an indirect method.

Mr. R. E. Buxton (Bruce Peebles & Co.) described the use of the computer in solving problems resulting from particular limiting conditions within each band of ratings over the complete range of designs. He referred to distribution transformers and the use of stock parts and drawings and said that the computer had available a range of standard core diameters, limb centres and window height or leg length and tried to arrive at a satisfactory design modifying only those values, suitable automatic adjustment being made to the reactance gap where necessary in order to converge to a final design.

Mr. F. W. Gee said that it would be easier to make comparisons if a paper were available on the human brain applied to the design of large power transformers. It would then be realised that different designers approached design in different ways and therefore produced different types of programme, some having an advantage in one field and some in another. Experience suggested that it was the competent and experienced designer who must produce the programme, not the computer expert.

Mr. E. R. Hartill (Metropolitan-Vickers Electrical Co.) thought a large proportion of design would still have to be done by hand. Computer breakdowns were probably teething troubles but they would have to be taken into account. Cost would also have to be reduced considerably; it was surprising how little computation could be done for £1,000.

Mr. A. R. Telford (British Thomson-Houston Co.) said that one of the main difficulties was to design round existing sizes of cores and cylinders. He welcomed the intention of the authors to extend their work. The writing of programmes was a fascinating task, and the more one read about other people's programmes the more bright ideas one picked up.

Mr. K. S. Rowe (Ferranti) observed that in the range of transformers referred to, the losses were not always known at the quotation stage. A different method of convergence was therefore required to arrive at the optimum quotation design. He described how his company had made provision for this in its own programme.

Mr. McGregor Ross (Ferranti) said the paper described an interesting exercise in interplay between the designer and the computing machine. It illustrated also how rapidly iterations settled down to an adequately accurate or tolerable solution. Usually 1 to 3 per cent improvement could be obtained in some desired characteristic. This could represent an important saving in one of the raw materials or in total cost.

Mr. J. E. L. Robinson referred to the salient advantages of a digital computer, such as the time saved by the designer, the accumulation of background experience, in which hitherto there had been many gaps, and the inclusion of calculations previously ignored because of lack of time or experience. In some cases, he said, there was a small but significant saving of material.

Mr. B. J. Chalmers (graduate) asked whether a similar approach to that described could be adopted in a problem with, say, five independent variables and three required quantities to be obtained within specific tolerances.

Mr. B. M. Bird (student) pointed out that the overall design of a machine need not be studied by computer operation provided the design parameters were within limits prescribed by the designer. As a result of work by designers, past and present, transformers were well understood. It had been said that the machine could not compete with the shrewdness of the designer, but though the machine was not "shrewd," it worked far faster.

NEW E.D.A. FILMS

THREE new agricultural films have been added by the British Electrical Development Association to its series of films on rural electrification, making a total of ten on this subject now available from the Association. The new films, which had a private showing in London last week were "Electric Grain Drying" (running time, 12 minutes), "Electricity for Hot Water and Steam in the Dairy" (10 minutes) and "Green Crop Conservation" (in colour, 12 minutes).

The first of these is essentially an instructional one for young farmers and agricultural students, but it will be of interest to all who are concerned with the harvesting and storage of grain on farms. The principles of artificial drying are dealt with in detail with the aid of animated diagrams, and their application by means of electrically operated equipment is shown. Grain is normally dried and stored on the farm either in sack or in bulk. The film therefore deals with the subject of layout and operation for both these methods. The use of actual farm installations combined with drawings and animated diagrams helps to make this film an effective aid to the study of grain and storage on the farm.

The film on clean milk deals with the cleaning of milking equipment and the necessity for adequate hot water. The wide range of farm-type as well as general service electric water heaters available for use on dairy farms is dealt with and principles and applications explained. Details of design and installation are shown by animated diagrams and the actual installation scenes underline the conditions of usage. Steam sterilisation is still the most efficient method of ensuring that utensils and equipment are sterile and the principles of its operation are demonstrated.

The film "Green Crop Conservation" deals with the making of hay and shows that the use of a barn hay dryer makes it possible to extend the haymaking season and to plan the conservation of definite quantities of high-quality hay for winter feeding of livestock. The principles of the cold air method are explained and installation requirements are illustrated. The use of warm and cold air for drying field-wilted grass is also dealt with, with particular reference to the detailed operation of these dryers together with their dual-purpose aspects.

The films, in 16 mm and 35 mm, are available from the Association, 2, Savoy Hill, London, W.C.2.

Australian News

It is reported that the Federal Government has been surveying the possibility of generating hydro-electric power in south-western Papua for use in the production of aluminium at Weipa, on the Australian mainland.

The Tully Falls hydro-electric scheme was officially opened by the Premier of Queensland recently. Some £13 million has so far been spent on the project. A major interconnecting transmission line has been constructed from Tully Falls to Townsville, linking the supply systems of the Cairns and the Townsville Regional Electricity Boards. The initial installation at Tully Falls power station consists of two 18 MW turbo-alternators and two more sets of a similar size will be installed later on. The scheme may not be completed until 1960.

The New South Wales Electricity Commission is calling for tenders for steam-raising plant to be installed at Lake Macquarie, near Newcastle. It is estimated that it will cost some £10 million.

NEW ELECTRICAL EQUIPMENT

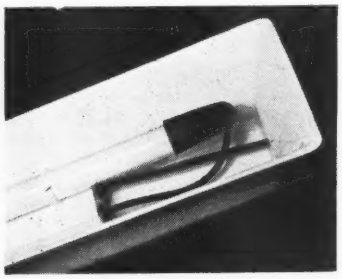
Fluorescent Fittings

Single-lamp 5ft fluorescent fittings especially designed for use in humid atmospheres have recently been made by A.E.I. LAMP & LIGHTING CO., LTD., Crown House, Aldwych, London, W.C.2, for special projects. Two types will be available, the standard "Watershed" fitting suitable for use in all non-corrosive atmospheres of high humidity, and the anti-corrosion design which will withstand highly corrosive conditions.

Both fittings consist of a "Perspex" or p.v.c. combined watershed and reflector providing a cut-off and protection for the lampholders and the compact metal box housing the auxiliary gear. The power pack used with the standard type is of heavy gauge sheet steel, "Bonderized" and stove-enamelled white. Switchless starter gear is used. The b.c. type lampholders are of white plastic with slip-over end shields. The anti-corrosion fitting is basically the same as the standard fitting, but the power pack and the lampholders are fully protected against corrosive agents.

Fixings for both types are at 42in centres and either hook or $\frac{3}{4}$in conduit suspension may be used.

The prices, including a p.v.c. reflector, are £11 10s 4d (standard) and £13 0s 4d (anti-corrosion). Fitted with an opal "Perspex" reflector the cost is 17s 8d extra. The prices include control gear, but not the lamp.



A.E.I. anti-corrosion "Watershed" fitting

Wiring Accessories

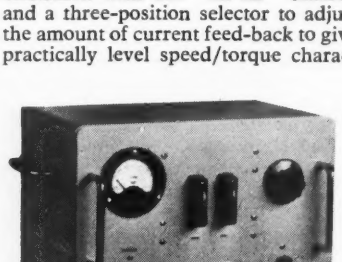
New 13 A accessories announced by I.R.L. PRODUCTS, LTD., Upper Bristol Road, Bath, Somerset, include a three-way shuttered multi-adaptor and a fused plug top. The adaptor, in brown, is priced at 8s 9d (ivory 10s) and the plug top retails at £1 10s 6d per dozen in either brown or cream.

F.H.P. Motor Speed Controller

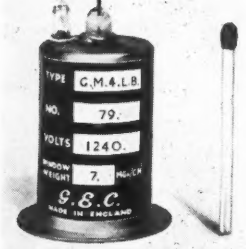
Smooth speed control, independent of load, is claimed for the magnetic-amplifier operated controller offered by SELIG ELECTRO-MAGNETICS, LTD., 296, Kilburn Lane, London, W.10. The present standard model is designed for use with a $\frac{1}{10}$ h.p. "Klaxon" motor and operates from 230/240 V, 50 c/s mains. The motor is connected by means of a four-core cable, and provision is made internally to allow the connection of a foot-operated or remotely situated speed control potentiometer in addition to the one supplied with the equipment.

Apart from the speed control knob, there is a reversing switch which is combined with the "on-off" control, and a three-position selector to adjust the amount of current feed-back to give practically level speed/torque characteristics over the whole of the 30 : 1 speed range. A novel type of speed indicator consists of a differential milliammeter calibrated directly in r.p.m. This takes account of the armature voltage of the motor and also its armature resistance drop which, of course, varies with load.

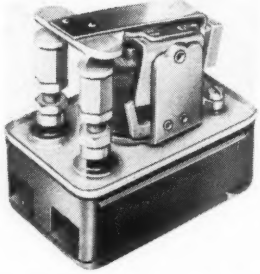
The equipment contains no valves and is extremely robust, being housed in an attractive stove enamelled sheet steel case.



Selig Electro-Magnetics f.h.p. motor speed controller



G.E.C. type GM4LB Geiger counter tube



Plessey 60 A bridging make hermetically sealed aircraft relay

Geiger Counter Tube

A new Geiger counter tube, type GM4LB, with an extremely low rate of count in the absence of the test specimen, has been developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, for the measurement of minute amounts of radioactivity.

It has a thin duralumin window of 1in diameter to admit particles from the specimen. The length of the anode wire has been kept to the minimum to reduce the response to any extraneous radiation, and the materials used in the construction have been specially selected to avoid radio-active contaminants such as potassium and lead which might contribute to the background count.

To obtain the minimum background response, the tube must be operated in a heavily-shielded enclosure and surrounded by a ring of gamma counters. This arrangement is called an anti-coincidence network and ensures that stray radiation from outside which passes through this ring is not recorded by the measurement tube. Background responses as low as 0·4 counts per minute have been obtained with this network, thus enabling specimens with an extremely low activity to be measured.

Gold Dip-Plating

A gold dip-plating process, known as "Atomex," has been introduced by the Baker Platinum Division of ENGELHARD INDUSTRIES, LTD., 52, High Holborn, London, W.C.2. The process requires no current or special equipment as the plating takes place by ionic displacement. Chemically attacked, the base metal surface sheds atoms into the bath which are replaced by atoms of gold from the bath.

Aircraft Relays

To meet the changing requirements of the aircraft industry, the PLESSEY CO., LTD., Ilford, Essex, has developed a new range of aircraft relays.

One of these is a 60 A bridging make relay, which is built to withstand severe conditions of shock, vibration, humidity and altitude. Operating over an ambient temperature range of −65 to +70 deg C, the relay is available

either hermetically sealed or dust-proof.

The hermetically sealed type weighs 10½ oz, 1 oz more than the dust-proof model, has a moulded terminal shroud and detachable terminal cover, whereas the terminals of the other are accessible by removing the dust cover. The overload capacity of both relays, which are wound for 28 V d.c., is 480 A d.c. at 60,000ft or 600 A d.c. at lower altitudes, non-inductive.

Fixing Bolts

The latest addition to the range of fixing bolts manufactured by PHILPLUG PRODUCTS, LTD., Wembley, Middlesex, is the "Studbolt" for use where articles to be secured, such as washing machines, industrial machines, turbines, etc., are placed in position before the bolt is fixed.

The "Studbolt" comprises a standard type set screw and washer with an expansion unit consisting of collar, lead spreader and threaded malleable iron wedge. The action of tightening the set screw draws the threaded wedge into the lead spreader which expands and locks the bolt in position.

Additional collars may be used to obtain a deep fixing and they can also be provided with special eye or hook bolts to suit all applications.

Overhead Line Tap

A new saddle tap has been designed by the ALUMINIUM WIRE & CABLE CO., LTD., 30, Charles II Street, St. James's Square, London, S.W.1, for efficient non-tension service connections on all forms of aluminium conductors. Of robust two-piece construction, these fittings are made of high strength, corrosion resistant aluminium alloy, screw threads being anodised to prevent seizing. They are readily applied or removed without the use of special tools.

Two sizes are available: ALT-1 accommodates conductor diameters in the range 0·177 to 0·366in (maximum combined conductor diameters, main plus service, 0·732in); ALT-2 accommodates corresponding diameters of 0·367 to 0·558in (1·038in).

These taps provide a large contact surface and have a continuous current rating of 60 A. A plastic shroud and sealing compound can be supplied for use with tap ALT-1 when it is employed for connections with insulated conductors.

Smoke Alarm and Density Indicator

LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, LTD., Rugeley, Staffs., announce that the British Standards Institution has granted licences covering the use of the B.S. "Kite" mark on their smoke alarm and density indicator series SME2. This follows independent evaluation of the equipment; it is a certification that the equipment complies with the appropriate standards and that it will also be manufactured under a scheme of independent supervision and control. It is believed that this is the first occasion on which any form of electronic equipment has been certified in this way.

The equipment meets both B.S. 2740 : 1956 covering smoke alarm and alarm metering devices and B.S. 2811 : 1957 covering smoke density indicators and recorders (provided that with B.S. 2811 an approved indicating meter is used with the equipment). This means that a smoke alarm installed to meet the requirements of the Clean Air Act can be converted to a smoke density indicator, and provide a simple form of combustion control.

Fluorescent Bulkhead Fitting

A bulkhead lighting fitting containing either two or three 8 W 12in fluorescent tubes is now being marketed by the WARDLE ENGINEERING CO., LTD., Old Trafford, Manchester, 2. The body and front frame are cast in aluminium alloy and secured by four steel captive screws. A thick resilient gasket ensures that damp and dust are completely excluded from the interior. The fitting is offered with either fluted clear glass or fluted "Perspex" securely held by full length clips and sealed to the frame.

The lamp control gear is mounted on the body and fully enclosed by a white stove enamelled reflector which is shaped to give the best possible results from the 12in lamps. The fitting is supplied ready wired to a 2-way porcelain terminal block.

The body design is such that it may be mounted on a flat surface or, alternatively, in the angle of wall and ceiling horizontally, or in a corner vertically. The standard finish is stove enamelled aluminium.

Wall Mounting Thermostat

An easily wired wall-mounting or conduit box fitting thermostat, model A70/15, has been introduced by CYRIL KIEFT & CO., LTD., 13, Dudley Road, Wolverhampton, Staffs. It is largely based on the company's original T/800 thermostat and is particularly suitable for floor warming installations and similar applications. The terminals are well spaced in the back of the thermostat, and it is fitted with a special back plate for conduit box fixing.

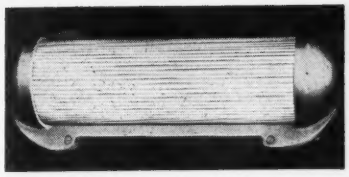
The metal cover, finished in stove enamelled ivory, is mounted on a walnut plastic base and it measures 4¼in by 2in. The price is £2 12s 6d.

Convector Heaters

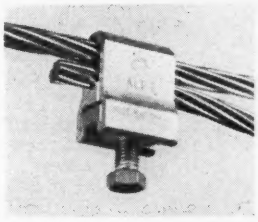
A new range of "Paramount" electric convector heaters, neatly styled in two colours, is now being produced by A. D. DAVIDSON ELECTRIC CO., 62, Granville Street, Birmingham, 1. The 1 kW model (F302) is fitted with a half-heat switch and measures 22½in high by 14in wide by 7½in deep. The standard 2 kW heater is also fitted with a half-heat switch (F304) and there is also a thermostatically controlled model (F306). The dimensions are 22½in high by 20in wide by 7½in deep.

All models are fitted with an aluminium grille and they are finished in either beige with gold grille or silver grey with ice blue grille. A carrying handle is provided at the back of the casing whilst cast feet keep the centre of gravity low and help to prevent accidental overturning.

The prices are £4 14s (F302), £5 19s (F304) and £6 14s (F306) plus £2 1s 2d, £2 12s 2d and £2 18s 9d, respectively, for purchase tax in the United Kingdom.



Wardle fluorescent lighting fitting



AWCO saddle tap

Kieft model A70/15 thermostat

Davidson "Paramount" convector

Electricity Debate

THE Paymaster General, Mr. Reginald Maudling, last week opened a debate in the House of Commons on the latest annual reports and statements of accounts of the electricity and gas industries. The electricity industry, he said, had a rapidly increasing demand, and its problem basically was more to find the capital required to finance the installations needed to meet that demand than to sell its product. Last year total sales were up by 6·7 per cent, and within that total sales to farms were up by 18 per cent. The average cost of electricity sold by the Central Electricity Authority was 4·7 per cent up on the year before. Since 1948 the cost of fuel had risen by 55 per cent and the revenue obtained per unit sold had risen by only 26 per cent. Those figures reflected a general improvement in the efficiency of electricity generation and distribution.

The industry's first problem was that of the raw material used, and to what extent it should rely on coal and oil. This would be particularly important in the early 1960s. Some new decisions recently made would lead to a reduction in the amount of oil used. Contracts had, however, been made with the oil industry at a time when supplies were greatly needed and it would be wrong for the industry to contract out of them. Further, they should not be misled by the present abundance of small coal into thinking that the situation would necessarily continue.

The next problem was the capital cost of developing the generating programme, particularly the nuclear programme. The Government's policy would not mean that the level of investment would fall; it would continue to rise, but at a lower rate than was previously planned. "There is to be no cut in the level of investment in electricity generation," he said, "but there is to be a slowing down of the present rising curve." The four nuclear power stations would go on as planned, but there would be some delay in starting the later stations and the net effect would be that the nuclear power programme would be completed one year later than the Government had announced. He re-emphasised that the Windscale type of accident could not take place at any of the C.E.A.'s new stations, and he announced that a formal code for the safe operation and design of nuclear power stations was now being prepared.

Competition, he said finally, must continue to be the basic principle of the co-ordination of the nation's fuel policy, but it must be competition with a good deal of Government guidance.

Cheaper Off-Peak Power Needed

Mr. Alfred Robens, the Opposition's leading spokesman, said that one of the electricity industry's great problems was that of load factor, which in 1956-57 was 43·26 per cent. This meant that hundreds of thousands of pounds of capital were lying idle for too many hours a day. Obviously, some method of storing electricity must be found—and a lot could have been done by the scientists if they had undertaken research with the same vigour as they devoted to nuclear energy research. Off-peak power, he suggested, should be made so cheap that it would pay to use machinery more during those periods than was now the case, and that it would pay to go in for storing electricity in a modest way by storage batteries. "That is the sort of incentive to offer manufacturers who have ideas about the storage of electricity," he said.

Mrs. Lena Jeger (Lab.) thought that waste of overheads could be avoided by combining electricity and gas showrooms. Mr. W. A. Wilkins (Lab.) considered that the time had come to consider bringing the two industries together, arguing that the element of competition was of little advantage, and Vice-Admiral Hughes Hallett (Cons.) also believed a strong case could be made out for a degree of merger between the two industries. On the other hand, Mr. Arthur Palmer (Lab.) said he would prefer to keep reasonable competition between them, because by combining gas and electricity there would be no true check on the real price of anything and free consumer choice would be destroyed.

Mr. Nabarro began by saying that the capital investment in electricity constituted the most expensive form of investment to-day in any of the nationalised industries. Wastage of resources was huge. He did not blame the industry, he said, but the Ministers responsible for fuel and power policy. The Herbert Committee had suggested an economic load factor of 48·2 per cent by 1959, yet since 1953 it had fallen from 44·4 to 43·3 per cent. A 1 per cent drop in load factor meant that 1 per cent of the capital assets of the electricity industry were not being used to greatest advantage. On the subject of load factor he supported the Herbert Committee's view that "the greatest single contribution that could be made to improve the British load factor would be the introduction of extended shift working in industry.

He then turned to the thermal efficiency of power stations which, he said, amounted last year to 24·93 per cent compared with 77·8 for the gas industry. This meant that three-quarters of the fuel used was being wasted.

The second wastage of the national resources could be seen in the Chancellor of the Exchequer's tax treatment of household appliances using electricity and gas. The load factor on the power stations was falling because the Chancellor was deliberately discouraging the use of such appliances by an onerous rate of purchase tax. Mr. Nabarro also spoke of the wastage through insufficient thermal insulation of houses.

The arguments for co-operation between the gas and electricity industries were touched on briefly by Mr. David Renton, Parliamentary Secretary to the Ministry of Power, who replied. He said that the Minister was not in favour of eliminating competition between the two industries, but he was in favour of a careful look being taken at the possibilities of co-operation. His answer to Mr. Nabarro about purchase tax on electrical appliances was that it was no part of his duty to poach on Treasury preserves.

Accidents in Mines

THE report of H.M. Chief Inspector of Mines for the years 1954 to 1956 (H.M. Stationery Office, 3s 6d) shows that the number of fatal accidents due directly or indirectly to the use of electricity was one in 1954, nine in 1955 and six in 1956, a total of 16 during the three years under review. Of the total, 11 occurred underground and five at the surface; 13 were due to electric shock. There were 61 reportable non-fatal accidents in 1954, causing injury to 74 persons, 66 in 1955 causing injury to 77 persons, and 55 in 1956 causing injury to 61 persons. In addition, three persons were injured in one of the fatal accidents in 1955. Thus, during the three years, 215 persons were injured—131 underground and 84 at the surface. There were 18 dangerous occurrences in 1954, 14 in 1955 and 14 in 1956.

The Chief Inspector says that far too often the Electrical Inspectors find it necessary to draw attention to slipshod practices. Trailing cables are allowed to lie about on the floor at the coal face, sometimes covered by debris; flameproof apparatus is used with set screws and bolts missing from the covers; machines, especially conveyors, are overloaded; leakage resetting devices are not locked and adequate means of identification is not provided for switchgear and cables. Such practices are potential sources of danger and must be avoided.

Another disturbing feature is the number of accidents which occur to electricians. In 1954 there were 51 electricians and 11 apprentices injured; in 1955 four electricians and one apprentice were killed, and 44 electricians and five apprentices injured; and in 1956 36 electricians and four apprentices were injured.

PARLIAMENTARY REPORT

Electrical Contracting Apprenticeship Scheme

Mr. Michael Stewart asked the Minister of Works why he had withdrawn his support from the national apprenticeship scheme in the electrical contracting industry.

Mr. Hugh Molson said he gave notice last January of his intention to discontinue the provision by his Department of secretarial services to the Apprenticeship and Training Council for the Electrical Contracting Industry because he felt that the time had come for this industry to manage its own affairs as other industries did.

Subsequently Mr. Arthur Lewis asked the Minister what action he proposed to take to prevail upon the employers to accept the proposals put forward by the chairman of the Training Council; and whether, pending an agreement between both sides on the introduction of a new scheme, he would maintain his control and direction over the secretarial and registration work connected with the Training Council.

Mr. Molson said he had asked the president of the employers' association to persuade his association and members to accept the proposals of the chairman of the Apprenticeship and Training Council, Sir George Gater, and find the necessary finance. "He explained to me that his members do not think registration necessary or useful," said Mr. Molson. "I was glad to learn that there will be no alteration in their support of training arrangements in the industry and particularly of indentured apprenticeship." Mr. Molson said he was continuing to provide secretarial services to the Council until arrangements had been completed for the future administration of the Council's Further Education Fund. He was not prepared, however, to continue the registration work beyond 30th November, 1957, the date fixed for its termination.

Solar Heat

Questioned by Sir Wavell Wakefield, Mr. Harmar Nicholls, Parliamentary Secretary, Ministry of Works, said that solar radiation was not at present being used in this country to produce high temperatures for research purposes. In the United Kingdom solar energy could never be used as regularly as in geographically more favourable parts of the world.

Russian Scientific Publications

Mr. Nicholls informed Mr. Albu that the Department of Scientific and Industrial Research had started a comprehensive collection of English language translations of Russian scientific and technological literature in all fields, excluding clinical medicine. The material collected was being made available through the Department's lending library unit. Microfilms of several thousand translations of Russian scientific papers had been ordered from a library in Chicago. The Department, in conjunction with the Scientific Library and Technical Information Committee of the Advisory Council on Scientific Policy, was reviewing the question of what additional measures were necessary to improve the volume of translations of Russian scientific papers and books.

D.S.I.R. and Development Contracts

In answer to Mr. Willey, Mr. Nicholls said that the D.S.I.R. had undertaken to consider proposals for contracts designed to promote developments of particular ideas, or in particular industries, in the public interest, when these were outside the scope of, or unacceptable to, the National Research Development Corporation.

Emigration of Engineers

Mr. Willey asked what action was being taken regarding the suggestions made about the emigration of scientists and engineers in the annual report of the Advisory Council on Scientific Policy, 1956-57.

Mr. Nicholls said the suggestion that British firms might make arrangements to interview British scientists and engineers in North America had been referred for consideration to the appropriate committees of the Federation of British Industries. The D.S.I.R. was considering what action could be taken to encourage more of our scientists and engineers to do post-graduate work in Europe.

Radioactive Waste

In reply to Mr. Dodds, Mr. Bevins, Parliamentary Secretary, Ministry of Housing, said the Minister was aware that a report on the fouling of water supplies by the discharge of radioactive waste into rivers was under consideration by the British Waterworks Association and the Department had offered to discuss the matter with them.

Technical Education

Mr. Geoffrey Lloyd informed Mr. E. Fletcher that since the publication of the White Paper on Technical Education in February, 1956, work had begun on eighteen new colleges and 79 major extensions of existing colleges. In addition to that, the final plans for five more new colleges and 17 further major extensions to a total value of £5 million had been approved, although work on them had not actually started. "We have already prepared sketch plans for a further 14 new colleges and 28 major extensions, to the value of over £8 million," he added.

The Brussels Exhibition

Referring to next year's Brussels Universal Exhibition, Mr. Arthur Palmer said that whilst appreciating the considerable efforts being made by British manufacturers privately, unless the resources of the State were put behind the British part of the exhibition our representation would not be fair to the industrial resources of this country.

Mr. Ormsby-Gore, Under-Secretary, Foreign Office, in reply, said he did not think there was any danger of that. The Government had contributed no less than £400,000 already to the British part of the exhibition, and he thought Mr. Palmer would find it was worthy of industry in this country.

Applications from Overseas Engineers

The Minister of Labour (Mr. Iain Macleod), replying to Mr. Albu, said that arrangements for interviewing overseas scientists and engineers who applied for positions in this country must in general be the responsibility of prospective employers, but he was considering what assistance his Ministry could give.

Prices of Cathode-Ray Tubes

Mr. Oliver asked the President of the Board of Trade if he would state the reduction in the retail price of television cathode-ray tubes since the manufacturers announced in October, 1956, that they were abandoning price control.

Sir D. Eccles replied that as far as he knew there had not been any major changes.

Volta River Scheme

Questioned about the possibility of British finance for the Volta River project in Ghana, Mr. Alport, Under-Secretary, Commonwealth Relations, said the report of the Preparatory Commission showed that there were certain conditions which would be prerequisite to any decision about the implementation of this project. Some of the major decisions which would be necessary could only be taken by the aluminium companies, whose contributions of capital to the project would be large. The United Kingdom Government must await the outcome of the discussions between the Ghana Government and the aluminium companies.

CEILING LIGHTING

A NEW form of luminous ceiling, claimed to be different from anything previously available in this country, has been designed by Crompton Parkinson, Ltd., in association with the Wakefield Co., Ohio, and is now being manufactured at the Doncaster works of Crompton Parkinson, Ltd. It is to be marketed under the name of "Modulume." These ceilings combine all the lighting equipment, lamps and wiring channels.

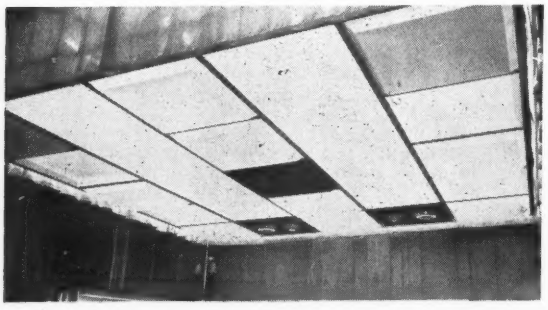
Designed upon a 36in module, there are two basically different forms of ceiling. One of these uses rigid arched pans of white translucent p.v.c. copolymer material measuring 36in square by 2½in deep which are practically non-inflammable. The pans may be reversed to give either a coffered effect or to protrude a couple of inches below the general level of the supporting framework. Alternating arrangements produce texture effects which may be varied still further by the use of colour. The strip type ceiling uses conventional corrugated vinyl white diffusing sheet based on a nominal 36in module width and in lengths of 30in. Combinations of strip and pan type ceilings can be arranged as the basic module is identical for both.

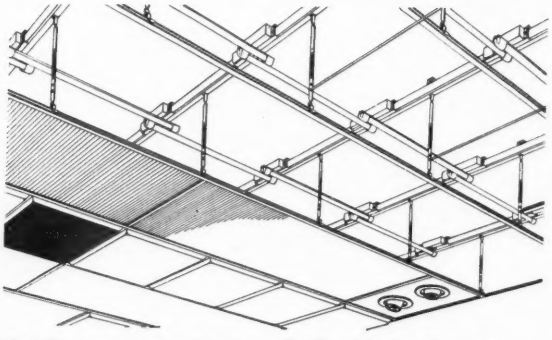
The ceilings require the minimum of attachments to the building structure; e.g. a ceiling of 15 by 12ft, including the trunking and lighting equipment, would be suspended from only eight points. Attachment of the trunking to the ceiling is by single screw fixings, spaced up to 15ft apart. The trunking is galvanised and has ample capacity for electrical conductors and tap-off arrangements to feed auxiliary equipment such as spotlights, down-lights, etc. Clipped to the base aperture of the trunking are adjustable vertical hangers which, at their lower ends, are firmly gripped to the satin finished fluted aluminium sections forming the framework of the luminous ceiling. Locking devices rigidly hold together the framework sections to form multiples of the basic module size, the whole frame having overall dimensions 2in wider than the module multiple.

Access to lamps or other equipment for maintenance or cleaning entails the removal of appropriate pan or strip diffusers, allowing all parts of the plenum space to be reached. Cleaning requirements vary with circumstances but dry dusting should be carried out about every two months and more complete cleaning by washing at intervals of nine to twelve months.

Minimum depths of plenum—the distance from the structural ceiling to the "Modulume" ceiling—should be about 15in, with ideal depths in the region of 24 to 30in. The more shallow the plenum, the greater the number of lamps required for even brightness of the ceiling. Figures of 35 to 50 ft/candles will usually be provided with reasonable plenum depth and average light decoration of interior walls. With shallower plenums, far higher intensities, up to 100 ft/candles or more, can be attained.

For complete ceilings, including all electrical equipment but excluding cable and installation charges, prices of from 15s to 21s per sq ft may be expected. Of this price the framework and luminous diffusers represent approximately 50 per cent. As all lighting equipment is included in the "Modulume" construction, there are no additional charges for the supply and installation of lighting fittings.





Complete Crompton Parkinson "Modulume" ceiling specially installed for demonstration purposes. On the right are the various components including strip and pan diffusers, spot-light panels, lightweight framework, hangers, "New-Line" lighting trunking and fluorescent lamps

Standard Frequency Transmissions

A new edition of the pamphlet describing the standard frequency transmissions from the United Kingdom has just been published by the National Physical Laboratory. These radio transmissions are broadcast almost continuously from the Post Office station at Rugby. They enable anyone needing precise frequency to check his apparatus against a standard which is known to one part in ten thousand million.

The pamphlet announces that the frequencies are now based on the resonant frequency of the caesium atom. Provisionally the value of 9,192,631,830 c/s has been adopted for this. This frequency is a fundamental physical constant, free from the small corrections and uncertainties associated with astronomical time. The precise value of the frequency is based on the value of astronomical time for 1955.

Some years must pass before the astronomical and atomic units can be compared to the full accuracy attained by the atomic clock because astronomical time must be averaged over a long period to eliminate small errors and uncertainties of measurement. If any corrections prove necessary in years to come, they can readily be made and therefore will not restrict the accuracy already available.

The frequencies and modulations are maintained to ± 5 parts in 10^9 but are monitored to ± 1 part in 10^{10}. The results published in *Electronic and Radio Engineer* are given only to 1 part in 10^9 to allow for slight transmission and propagation errors, but even more precise average values can be used when steps are taken to eliminate these errors.

A pamphlet entitled "MSF—Standard Frequency Transmission from the United Kingdom" is available free on application to the Director, National Physical Laboratory, Teddington, Middlesex.

EPOXIDE RESIN MOULDINGS

New Applications for High-Voltage Insulation

By J. R. FERGUSON, A.M.I.Prod.E.

RECENT developments and production experience in the hot casting of a particular epoxide resin (" Araldite " resin " B ") has re-emphasised its potential importance in the field of high-voltage insulation. The resin itself is filled, after melting at 160 deg C, with carefully selected and processed filling agents, usually of silica. It is subsequently poured under vacuum into metal moulds and cured for approximately five hours.

Although the choice of filling agents can produce limited advantages, one against another, the basic properties of the epoxide resin, which make it so useful as a high-voltage insulation are already established, namely:—high dielectric strength, excellent anti-tracking qualities, good non-hygroscopic properties, adequate mechanical strength when correctly applied, and resistance to a wide range of chemical liquids and atmospheres. So far the majority of the applications of the hot cast epoxide resin has been on inside, or protected installations, because of the apparent action of ultra-violet rays from direct sunlight on the resin. Work, however, is going on, both in this country and on the Continent, to resolve this problem.

In the field of high voltages (3·3 to 15 kV) the initial use of the resin has been for the construction of moulded current transformers and, following this, voltage transformers. The Continent has swung very considerably to this method of manufacture in the last few years, as their cellular types of equipment could adopt them with advantage. In this country the use of oil and/or compound-filled chambers has made the change-over a more gradual process, as design alterations are invariably involved.

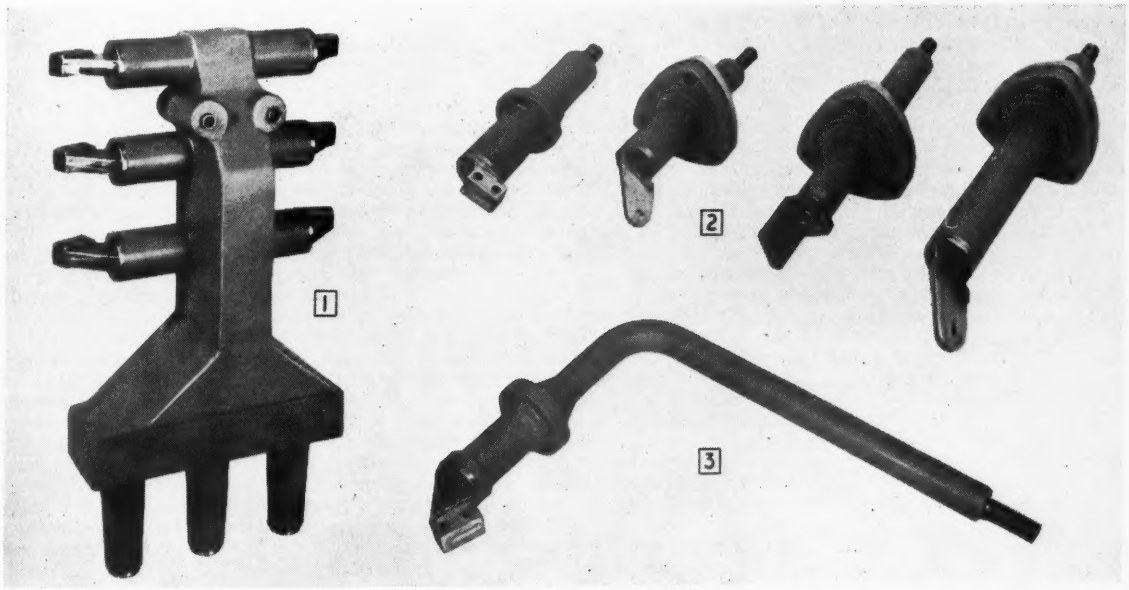
Nevertheless, moulded current transformers are now in quantity production (see *Electrical Review*, 10th August, 1956) and although their cost is not below that of the taped construction, a well-designed transformer can be strictly competitive on all-round performance. Recently, however, it has been in the manufacture of constructional items such as bushings, arc control devices, busbar coverings, busbar chambers, etc., that hot cast epoxide resin mouldings have begun to exert an effective influence on the trend of designs. The material is expensive, and has to be used sparingly, but the insulation quality is so good, and the possibility of casting it in complicated shapes, so obvious, that its increased use in new switchgear, for example, is already guaranteed.

Moulded arc control devices have been successfully proved for 250 MVA, 11 kV circuits with negligible erosion under the action of short-circuit power arcs under oil. A busbar chamber, specifically designed in "Ethox"* is shown in Fig. 1. Weighing over 50 lb, the chamber has been constructed and proved for a 250 MVA, 11 kV ring main circuit with a " tee-off " having a fault capacity of 150 MVA. In components of this size the epoxide resin is used to good advantage, and in this case the company concerned (Long & Crawford, Ltd.) saved the use of an intermediate chamber 18in wide.

The problems associated with this type of construction are largely mechanical in nature, as the excellence of epoxide resin as an insulation medium provides no electrical problem. On the mechanical side, the passing of short-circuit currents for periods of up to 3 sec causes heat to be generated in the copper conductors which must be dissipated through the resin. The expansion and contraction of the copper can be either accommodated by

* Registered trade name of J. R. Ferguson (Electrical Engineers), Ltd.

Fig. 1.—Busbar chamber weighing over 50 lb made from " Ethox." Fig. 2.—Group of leak-proof epoxide moulded bushings showing (top left) a cable box bushing with a condenser layer for neon lamp indication. Fig. 3.—A conductor/busbar moulding replacing expensive tape insulation



slight flexibility in the epoxide itself, or by relative movement between the two components, or possibly by a combination of both. At the same time the choice of the section of the copper must be correct, as well as economical.

In the field of high-voltage bushings, considerable development and production experience has already been gained in the use of epoxide resin. The bushings, so developed, have largely either replaced porcelain, by a mechanically stronger, if somewhat more expensive arrangement, or have replaced bushings previously made of synthetic resin bonded paper. Epoxide bushings can invariably show a 15 to 20 per cent reduction in cost over the latter, as well as being a better technical product.

Fig. 2 shows such a series of bushings including one with a condenser layer moulded internally for neon lamp indication. These bushings have been specifically designed for mouldings, and incorporate a moulded flange to provide an excellent arrangement for a leak-proof joint.

Proving tests have been carried out at every stage of development, and considerable data is now available to enable the design of moulded bushings to be undertaken in full confidence of their performance during the passing of short-circuit currents. Bushings have been subjected to typical short-circuit currents as shown in the following extract of test results obtained by the British Thomson-Houston Co., Ltd. The choice of the section of copper is related to the value and duration of the short-circuit current, equally to the normal current rating usually applied.

Test No.	Short-circuit r.m.s. Current in kA Start	Final	Duration of Test	State of Bushing
C.943	28	11	3 sec	Satisfactory
C.944	33·6	17·6	3 sec	Satisfactory
C.945	37	21	9 sec	Cracked at conclusion of 9 sec

Other tests have been carried out on bent and formed conductors to establish the limit of expansion and contraction of various arrangements of epoxide-covered busbars. Typical of these is a conductor/busbar arrangement shown in Fig. 3. The results of testing such an arrangement to destruction are shown in the following table:—

Test No.	Short-circuit r.m.s. Current in kA Start	Final	Duration of Test	State of Bushing
D.120	20	12·2	3 sec	Satisfactory
D.122	17·5	12·2	5 sec	Satisfactory
D.123	29	19·6	5 sec	Cracked after 5 sec at 20·8 kA

As a result of experience gained in extensive development investigations it has now been possible to design a range of standard epoxide bushings from 3·3 kV to 15 kV, suitable for systems having a maximum short-circuit r.m.s. current capacity of 22 kA for 3 sec.

Cost reductions will result from using these standards as the epoxide resin bushing invariably shows a saving over s.r.b.p. bushings, whilst no tool charges are incurred. Two further sets of standards, namely, for post-type insulators and cable box insulators, are already in course of development. This form of insulation seems likely to quickly find its way to the front in new designs of switchgear, transformers and other electrical equipment, particularly for the price-conscious export market.

Load Development in Ontario

IN a report of some 290 pages the Hydro-Electric Power Commission of Ontario gives a detailed review of its operations in 1956. With the continued growth of the Province both in population and productive output, there was a substantial increase in power supplies, which amounted to 29,523 million kWh (11·2 per cent more than in 1955); about 85 per cent of this was generated in the Commission's 65 hydro-electric and five thermal stations. The main consuming centres are in the area of the Southern Ontario system, where the bulk of the output was generated at the two Sir Adam Beck-Niagara stations (11,270 million kWh). The two largest steam stations, Richard L. Hearn (Toronto) and J. Clark Keith (Windsor), generated 736 million and 183 million kWh, respectively. In the whole of the Commission's area, an aggregate of 27,000 million kWh was delivered in bulk to 350 municipal utilities, 29 local distribution systems, 206 direct industrial customers and 105 operating areas in the rural power district.

Direct primary supplies to industry amounted to 8,174 million kWh, the four major consuming industries being mining (2,140 million kWh), pulp and paper (1,705 million), chemical and electro-chemical (1,444 million) and steel and electro-metallurgical (1,060 million). The steel and metallurgical group registered the largest proportional increase (20 per cent), followed by the mining group (15·8 per cent). The latter included substantially larger power supplies for uranium mining (59 million kWh compared with only 8 million in 1955).

The pace of the Commission's frequency standardisation programme was further accelerated, the number of items converted in some areas being 30 per cent more than in the previous year. By the end of the year the equipment of about 75 per cent of consumers included in the programme had been dealt with and it is now expected that the whole of the Southern Ontario programme will be finished by the summer of 1959, two years ahead of schedule. Improved techniques have made it possible to reduce the cost of conversion in some instances. With refrigerators, for example, about $1,350,000 was saved last year by replacing the motor compressors only. Studies are being carried out to extend the method and to adapt salvaged compressors for 60 c/s operation.

The principal generating plant construction works in hand during the year were the Sir Adam Beck-Niagara No. 2 station, scheduled for completion in 1958, and the St. Lawrence power project, which is planned for initial operation in the same year. Thereafter there will be a gradual transition from predominantly hydraulic to thermal generation, and a beginning has already been made on the enlargement of the Richard L. Hearn steam station.

Important projects are also in hand for the extension of transmission facilities. The first towers of a new design, lighter in construction and higher than those formerly used, have now been erected, permitting longer conductor spans. In co-operation with manufacturers, designs have also been prepared for lighter conductors.

A section of the report deals with the Commission's extensive testing and research facilities. Developments mentioned include the following:—Concrete in which fly ash replaced about 30 per cent of the normal cement content was used for girders forming the roofs of ice sluices. A borehole camera was devised for determining the character of faults or voids in rock or concrete. A gantry crane for the St. Lawrence powerhouse dam will receive power via a collector arm from three busbars in a recess 4ft above the powerhouse deck and a protective closure system was designed using overlapping neoprene strips with an entry for the collector arm. A polarisation cell was constructed to facilitate cathodic protection of pipe-type cable installations. Other investigations concerned oil deterioration, babbitt-bearing corrosion and the resistance of metals and alloys to cavitation pitting.

Half-Wave Magnetic Amplifiers

By G. M. ETTINGER, M.Sc.

Summary by the author of a paper read in London to the Institution of Electrical Engineers, on 3rd December and to be published in full in the "Proceedings of the Institution," Vol. 105, Part B (1958).

THE paper discusses the half-wave type of magnetic amplifier[1,2] which has the advantages of fast (less than one cycle) response and simplicity. Half-wave magnetic amplifiers can be employed in bridge circuits[3] (Fig. 1) to give either d.c. or reversible phase a.c. output; their input, also, can be either d.c. or a.c. at the same frequency as the power supply.

Previous analyses for magnetic amplifiers have generally assumed very low, or infinitely high, control circuit resistance and perfect rectifiers. The present paper is concerned with the more common case of finite control circuit resistance or rectifier leakage. Clearly, with finite ampere-turn gain, the assumption of zero control circuit resistance leads to infinite power gain and the assumption of infinitely large control circuit resistance to zero power gain.

The gain of a half-wave magnetic amplifier (Fig. 2a) is related to full-wave magnetic amplifier gain by a "reset factor" which is an exponential function of circuit magnification (Q) during the reverse half-cycle of the excitation voltage, while the core is not saturated. Dependence of this reset factor on core material and rectifier properties and on bias circuit impedances is discussed and simple expressions are derived which may be used to determine optimum control circuit resistance or optimum turns ratio.

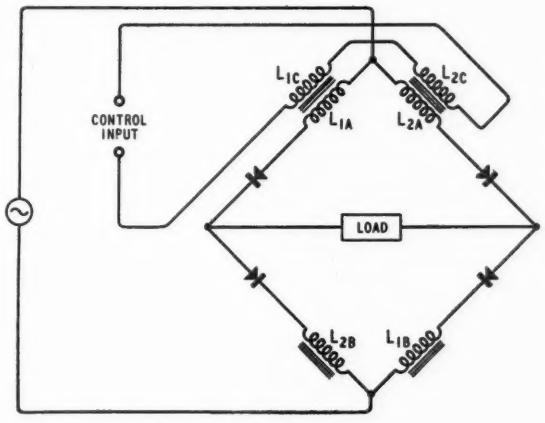


Fig. 1.—Half-wave bridge-connected magnetic amplifier

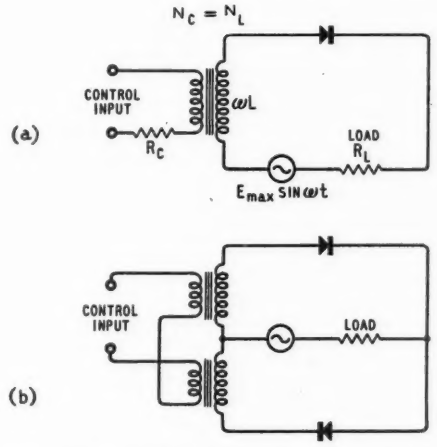


Fig. 2.—Magnetic amplifier circuits: (a) half-wave: (b) full-wave

For a half-wave magnetic amplifier which has the parameters shown in Fig. 2a, the reset factor has the following magnitude:

$$F = 1 - e^{-\frac{\pi R_c}{\omega L}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1A)$$

where core material with a truly rectangular hysteresis loop (unity rectangularity coefficient[4]) is employed. Such materials are not available in practice; in particular, the susceptibility even when the core is "saturated" is still much greater than unity. Thus, a core of permeability 20,000 and rectangularity coefficient 0·98 has a saturated permeability as high as 400. Therefore the hysteresis loop shown in Fig. 3b should be used for magnetic amplifier analysis, rather than the ideal loop of Fig. 3a. From the slope of the saturation line of the hysteresis loop, or from a normal a.c. magnetisation curve, the phase angle θ of the load circuit during the saturation period can be determined. This quantity enters the expression for reset factor as indicated in equation 1B below:

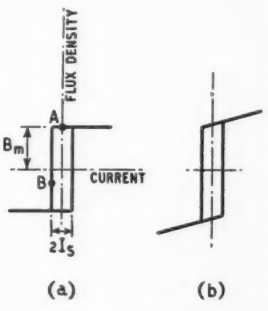


Fig. 3.—Hysteresis loops of core material: (a) idealised; (b) practical

$$F = 1 - e^{-\frac{(\pi - \theta)R_c}{\omega L}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1B)$$

Sensitivity

From a knowledge of the reset factor and of the load circuit parameters, the current gain (S) and the power gain (A) of a half-wave magnetic amplifier can readily be computed. Thus,

$$S = F\frac{k\,\omega L}{2\pi R_L} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{and } A = S^2\frac{R_L}{R_C} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where k is the ratio of control turns to load turns.

It is shown in the paper that maximum power gain is obtained when the turns ratio k is equal to $1{\cdot}58\sqrt{R_c/\omega L}$. Where this condition is satisfied, the maximum possible

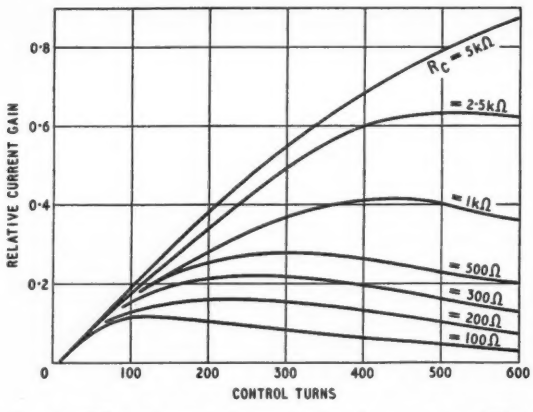


Fig. 4.—Effect of turns ratio on Mumetal magnetic amplifier current gain

power gain of a half-wave magnetic amplifier with resistance load is found to be:

$$A_{max} = 0{\cdot}032\,\frac{\omega L}{R_L}$$

This equation applies with perfect rectifiers. It may be employed with reasonable accuracy provided rectifier reverse resistance is greater than twice the unsaturated load circuit reactance ωL.

The analysis is supplemented by measurements on magnetic amplifiers wound on cores of various materials. It is shown that the effects of rectifier leakage are qualitatively similar to those of control circuit resistance. Fig. 4 shows the dependence of the current gain of a small Mumetal magnetic amplifier on control turns and control resistance. Maxima of current gain are seen to depend on turns ratio as well as on control circuit resistance.

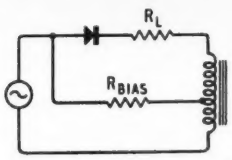


Fig. 5.—Half-wave magnetic amplifier circuit with part-winding a.c. bias

The effect of various bias circuits on the performance of half-wave magnetic amplifiers is discussed and a technique termed "part-winding a.c. bias," as illustrated in Fig. 5, is recommended. Here the operating point of the magnetic amplifier is controlled by unrectified alternating current passed through a portion only of the load winding, so that a separate bias winding is not needed.

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TRANSISTORS AND D.C. AMPLIFIERS

IN addition to the foregoing paper summarised by the author, three papers were presented before the Institution of Electrical Engineers on the same evening by Dr. G. B. B. Chaplin and colleagues of the U.K.A.E.A. In two of these Dr. Chaplin's collaborator was Mr. A. R. Owens on the subject of high gain d.c. amplifiers, in one case with reference to transistor input stages and in the other to transistors of the chopper type.

In the former instance it was pointed out that sensitivity of a d.c. amplifier (determined by noise) was limited mainly by thermal drift of operating point due to variation with temperature of inter-electrode potentials and currents of a transistor. The least drift was obtained when the transistor was used as a chopper. For a low-frequency germanium transistor, the maximum voltage and current drifts between 20 and 50 deg C were 100 microvolts and 3×10^{-8} A, without recourse to selection or balancing of transistors. With high source impedance the current drift became the limiting factor. These drift figures compared favourably with those of thermionic valves and should enhance the value of transistors in such applications as analogue computers and high-sensitivity null detectors. The silicon junction transistor, having leakage currents less than one-thousandth of that of the low-frequency germanium types, might enable direct currents of less than 10^{-11} A to be measured.

The transistor chopper amplifier described in the companion papers was found to compare favourably in regard to reliability, heat dissipation and power drain with high-gain thermionic valve d.c. amplifiers. It formed part of a modulated system consisting of a transistor input chopper, a high-gain a.c. amplifier (using four transistors) and a transistor output chopper. Referred to the input, the current drift was 4×10^{-9} A and the voltage drift was less than 100 microvolts between 20 and 50 deg C.

In the remaining paper Mr. R. Williamson was associated with Dr. Chaplin in dealing with dekatrons (cold cathode decade tubes) and electro-mechanical registers operated by transistors, as used in nucleonic work for counting pulses occurring at the relatively long intervals of 250 microsec or more. In the circuits described the dekatron was driven by a transistor blocking oscillator, which produced pulses of defined amplitude and width of alternate opposite polarities. The system lessened the delay between input and output pulses to a few microsec, which was the triggering time of the oscillator, thus reducing the error when the dekatrons were used for counting standard time intervals. For operating a mechanical register two transistors were cross-coupled in a monostable circuit. The register was in the collector circuit of one transistor, which conducted for 0·1 sec when triggered. The transistor circuits produced accurate waveforms, thus minimising the resolving times.

Schoolchildren's Christmas Lecture

THE North Western Centre of the Institution of Electrical Engineers is arranging for a lecture for older schoolchildren to be given in the Christmas holidays. The title of the lecture is "The Silent Miracle," and it will be given by Mr. A. R. Cooper, at 3 p.m. on 27th December, at the College of Science and Technology, Manchester, 1; on 28th December at the Bolton Technical College, Manchester Road, Bolton; and on 30th December at the Royal Technical College, Peel Park, Salford. The theme will be photosynthesis and its role in the production of fuel used in the generation of electricity. Applications for tickets should be made by 12th December to Miss H. Lucas, Room B. 46, Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, 17.

Electronic Telephone Director

First Installation at Lee Green Automatic Exchange

NEW electronic equipment, which when working at full capacity will be capable of routing over a hundred telephone calls to different destinations simultaneously, and is expected to make an important contribution to the Post Office's plans for the widespread introduction of automation referred to in the recently published Government White Paper, began operating at the Lee Green, London, automatic exchange last week. The equipment, which was officially inaugurated by Sir Lionel Harris, engineer-in-chief of the Post Office, is the first of its kind to go into operation in this country, and employs a "magnetic drum" storage device similar to those used in computers.

The drum is a bronze cylinder, 12in in diameter by 3in deep, which has a capacity for "remembering" numbers and translating them into routing instructions far greater than the combined efforts of several of the most skilled manual switchboard operators. It can make connections more efficiently than its human counterpart, and in order that the rare mistake should not go undetected, it incorporates supervisory circuits.

Known as the magnetic drum director, this electronic telephone controlling equipment has been developed by the Automatic Telephone & Electric Co., Ltd., and is a big improvement on the existing electromechanical equipment in use in London and other large cities throughout the world. Its functions are, however, basically the same; it must "store" the dialled numbers, translate them into routing directions, and ensure that calls are put through in the shortest possible time.

Some 700 different instructions can be stored on the magnetic drum, and from these it is capable of translating any demand for a call into routing data in only one-tenth of a second. This high operating speed gives it many advantages over any equipment previously available. The new equipment will for some time be undergoing extensive "field trials," during which its performance will be closely studied handling public telephone traffic under normal operating conditions.

In his inaugural speech, Sir Lionel Harris said that in Britain since the war the Post Office and manufacturers of exchange equipment had studied the problem of employing electronic methods of switching. All had made contributions and latterly all had pooled their research and development resources to concentrate effort in this field. The firms concerned were the Automatic Telephone & Electric Co., Ltd., Ericsson Telephones, Ltd., the General Electric Co., Ltd., Siemens Edison Swan, Ltd., and Standard Telephones & Cables, Ltd. Various electronic and semi-electronic exchanges had been built and operated since the war within these organisations, but now a concerted effort was being made on the design of a system suitable for the public service of the future with all its complications. It was anticipated that a trial exchange would be opened in 1960 at Highgate Woods which would provide information to guide the Post Office's future course.

Magnetic drum director at Lee Green telephone exchange

European Free Trade

AN address on "Britain and the European Free Trade Area: How the Trade Associations Can Help" was given on 29th November by Mr. Leslie Gamage, chairman and managing director of the General Electric Co., Ltd., at the monthly luncheon of the Secretaries' Club (an organisation of national trade association secretaries).

Among the points made by Mr. Gamage was that in the face of the European Common Market, which was a *fait accompli*, Great Britain was bound to join in a European Free Trade Area or be virtually excluded by high tariffs from the Messina countries, while Germany's goods would enter duty free. In such a case Germany would expand her basic "home" market threefold and thus be enabled to compete with us more strongly in world markets, including the Commonwealth.

Even though agriculture might not be exempted completely from Free Trade Area arrangements, he had little fear that Commonwealth producers would not be safeguarded and he thought that if United Kingdom trade were strengthened we would require more raw materials from Commonwealth countries and they would thus benefit.

Whether the Free Trade plans materialised or not, there was no doubt that British industry would have to undergo much change. British manufacturers would have to become increasingly competitive and concentrate upon goods for which there was the greatest demand and not on those which it was most convenient to make. Consumers' requirements must be more thoroughly studied than in the past; costs must be pruned and better (and better looking) goods must be made. Hitherto this country had been unable to exploit the inventions of our scientists because of our small home market. With a Free Trade Area we would have a European market of some 250 million.

Secretaries of trade associations could render good service to their members by keeping them informed about the Common Market and Free Trade Area, by discussions on the subject with Government Departments, and by urging upon members the need for making preparations now.

The chairman at the luncheon was Mr. S. H. Robinson (Mains Cable Manufacturers' Association), president of the Club, and a vote of thanks to the speaker was proposed by Mr. James Oldroyd (B.E.A.M.A.).

GENERATION AND DEVELOPMENT

C.E.A. Contracts

The Central Electricity Authority has placed contracts during the past month for power stations, transmission lines and transforming stations, amounting in the aggregate to £2,930,000. The principal contracts include the following:—

Brunswick Wharf power station, Poplar: Conversion of boiler to dual firing.—Clarke, Chapman & Co.

Staythorpe "B" power station, Newark: Structural steelwork.—Dorman Long (Bridge & Engineering).

Rugeley power station: H.p. pipework and valves.—Stewarts & Lloyds.

Fleet substation: 275 kV and 132 kV switchgear. — Metropolitan - Vickers Electrical Co. One 120 MVA 275/132 kV auto-transformer.—Hackbridge & Hewittic Electric Co.

Kirkby substation: 275 kV and 132 kV switchgear.—Ferguson Pailin.

River Usk crossing: 275 kV overhead line.—J. L. Eve Construction Co.

Sittingbourne and Thanet: 33 kV cables and pilot cables.—W. T. Henley's Telegraph Works Co.

Site for Ulster's Atomic Power Station

It is expected that Ulster's atomic power station, which Lord Glentoran, the N. Ireland Minister of Commerce, said should be finished in 1963, will be at Washingbay on the western shores of Lough Neagh in County Tyrone. Engineers are making boring tests in this area. Farmers in the district have been asked to have their lands valued.

Electricity Boards' Sales

The accompanying table analyses the sales by the twelve Electricity Boards in England and Wales. The national figures show an increase over October, 1956, of 6 per cent, but when corrected for weather conditions and working days the increase is 7·6 per cent.

Clarence Dock Smoke Emission

Speaking during the debate on the gas and electricity annual reports in the House of Commons, Mrs. Braddock referred to smoke emission from Clarence Dock power station. The Parliamentary Secretary to the Ministry of Power (Mr. David Renton), replying, said that the Minister of Housing and Local Government was to hold a meeting, to be attended by representatives of his Ministry, the local authority and the C.E.A., to consider the matter.

Reinforced Supply to Dagenham Works

With the commissioning recently of the new main substation at the Dagenham works of May & Baker, Ltd., a further step was completed in the planned scheme of reinforcement for this part of the Eastern Electricity Board's Essex Sub-Area.

The substation building, constructed by contractors employed by the company on a site in the canteen and amenities area to the specification of the Board, presents a pleasing appearance and harmonises well with the surrounding buildings. The layout provides for outdoor transformers and indoor switchgear and auxiliary plant. Initially two 10 MVA 33/11 kV Hackbridge-Hewittic transformers and a 9-panel Switchgear & Cowans 11 kV switchboard have been installed. There is also provision for the installation of two 15 MVA transformers and additional 11 kV switchgear.

To provide the incoming supply two new 0·25 sq in 33 kV three-core underground cables were laid from the Board's Forest Towns substation, the cable being supplied and installed by W. T. Henley's Telegraph Works Co., Ltd.

During the progress of these works the Board carried out, on behalf of May & Baker, the laying and jointing of a new 11 kV ring main within the works, the dismantling of obsolete switchgear from the four works substations and the re-equipment, involving the installation, testing and commissioning, of fifteen new Johnson & Phillips 11 kV oil circuit-breaker units. The change-over to the new system was completed without causing any interruption to the works output.

Rural Supply

At a cost of some £10,000 an electricity supply has been provided by the Eastern Electricity Board to the isolated village of Wickham St. Pauls, where there are about a hundred potential consumers, including fifteen or so farms. Speaking at the switching-on ceremony, Mr. G. N. H. Mayes, manager of the Board's Stowmarket District, expressed the hope that the service would be widely used, for cookers and water heaters as well as lighting and television, and to make farming more productive.

OVERSEAS

European Electricity Supply Statistics

The Economic Commission for Europe has published a supplement to Vol. 1 (May, 1957) of its annual bulletin, "Electric Energy Statistics for Europe." This document of 11 pages (obtainable at 1s from the United Nations, Palais des Nations, Geneva, or through national agents) gives additional and revised information that came to hand from a number of countries too late for publication in the main report. Its contents include data regarding maximum net capacities of power stations, both publicly and privately owned, up to 31st December last; kWh sent out and sold during recent years; fuel of different kinds consumed in the generation of electricity; average thermal efficiencies; and international exchanges of electricity.

Progress at Kariba

Last week the main channel of the Zambesi River encircled by a large coffer dam was pumped dry, reports the Salisbury correspondent of *The Times*. The coffer dam extends in two arcs from the south bank to link up with the foundation blocks of the main dam wall. The north bank coffer dam, inside which the earlier

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for October (million kWh)			Twelve Months' Totals Ended 31st October (million kWh)		
	1956	1957	Inc. or Dec. %	1956	1957	Inc. or Dec. %
London	610·6	622·3	+ 1·9	6,950·6	7,006·4	+ 0·8
South Eastern	389·5	400·5	+ 2·8	4,428·9	4,516·4	+ 2·0
Southern	483·3	517·9	+ 7·2	5,337·8	5,648·9	+ 5·8
South Western	240·5	249·6	+ 3·8	2,736·9	2,821·1	+ 3·1
Eastern	631·8	663·4	+ 5·0	7,036·4	7,318·1	+ 4·0
East Midlands*	540·6	572·7	+ 5·9	6,010·0	6,253·7	+ 4·1
Midlands*	689·1	737·3	+ 7·0	7,761·9	7,976·5	+ 2·8
South Wales*	403·4	431·5	+ 7·0	4,496·6	4,754·1	+ 5·7
Merseyside and North Wales*	416·5	445·9	+ 7·1	4,704·4	4,921·3	+ 4·6
Yorkshire*	702·8	744·1	+ 5·9	7,798·5	8,157·7	+ 4·6
North Eastern*	408·1	432·1	+ 5·9	4,474·9	4,719·0	+ 5·5
North Western*	724·6	768·0	+ 6·0	8,245·8	8,422·4	+ 2·1
Total all Area Boards	6,240·8	6,585·3	+ 5·5	69,982·7	72,515·6	+ 3·6
Direct Supplies by Central Authority	191·1	235·2	+23·1	2,167·2	2,367·6	+ 9·2
Grand Total	6,431·9	6,820·5	+ 6·0	72,149·9	74,883·2	+ 3·8
Mainly Industrial Areas*	3,885·1	4,131·6	+ 6·3	43,492·1	45,204·7	+ 3·9
Mainly Non-Industrial Areas	2,355·7	2,453·7	+ 4·2	26,490·6	27,310·9	+ 3·1

* Those in which industrial consumers took over 50% of the total sales in the preceding financial year.

foundations were laid, was blown up some months ago and the river is being diverted round the north side of the new circular coffer dam; on the south side it flows through a diversion tunnel.

Equator Crossing

On 16th November a rather unusual crossing of the equator was made in East Africa when the Uganda Electricity Board energised the Kenya Power Company's main 132 kV transmission line for test purposes.

For the past twelve to eighteen months Balfour Beatty & Co., Ltd., have been engaged on the construction of this line on behalf of the Kenya Power Co., Ltd., and the Uganda Electricity Board. The line, which extends for a distance of some 250 miles from a switching station at Tororo in Uganda to Nairobi, is for the purpose of conveying from Uganda for use in Kenya electricity generated at the Owen Falls hydro-electric station, 325 miles from Nairobi.

It is expected that supply on a commercial scale in accordance with the agreement entered into between the Board and the power company will commence early in the new year.

Second Nile Dam

The Minister of Corporations and Regional Communications of Uganda (Sir Amar Maini) announced recently that application had been made to the World Bank for money to finance the building of a second hydro-electric dam on the Nile. The proposed site is at Bujagali, a short distance below Owen Falls. The Uganda Electricity Board estimates that by 1965 the full capacity of the Owen Falls station will be needed to meet the demand.

Black-out in Ceylon

Electricity supplies in Ceylon were cut off for a time when 7,000 hydro-electric workers went on strike in sympathy with locomotive firemen who had already stopped work. Later the Prime Minister (Mr. Bandaranaike) persuaded the Electrical Department employees to return to work.

Distribution in Southern Queensland

The latest report received from the Southern Electric Authority of Queensland refers to the considerable extensions of the distribution system now being undertaken, particularly in the Darling Downs and South Coast districts. In the latter area the demand has increased fourfold since 1948. A good deal of line construction is across farmland and the report illustrates a section of single pole 110 kV line of the "wishbone" type which facilitates the siting of poles clear of the wheat-fields.

The 551·7 million kWh sold by the Authority in the year ended 30th June last represented an increase of nearly 12 per cent over 1955-56. Income from sales amounted to £6·2 million, the year's working resulting in a net surplus of £19,730. An additional 4,968 consumers were connected, making the total number 112,281. With the commissioning of the sixth boiler at Bulimba "B" the capacity of the Authority's stations was raised by 192 MW.

Turkish Hydro-Electric Scheme

As part of a hydro-electric and irrigation scheme being carried out in Turkey an artificial reservoir 46 miles long and nine miles wide is to be created at Hirfanli. Last week the Prime Minister (Mr. Menderes) sealed off the tunnels carrying the diverted waters of the Kizilirmak River so that the reservoir has now begun to fill. The contract for the scheme was placed with George Wimpey & Co. and the English Electric Co. in 1954 and the work is scheduled for completion by the end of next year. The power station will have an annual output of 400 million kWh and the dam will irrigate the Kizilirmak area of Anatolia.

Buried Power Transformers

IN heavily built-up industrial areas there is an ever-increasing problem of finding suitable sites for substations and on many occasions they have had to be erected at points farther from load centres than good practice demands. Underground or basement substations and transformer pits have also been resorted to.

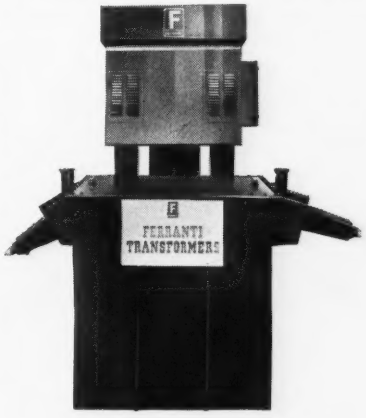
The South of Scotland Electricity Board, in conjunction with Ferranti, Ltd., has for some time been seeking new means of dealing with the difficulty. What is hoped will prove to be an adequate solution is the development of a transformer which can be buried in the street or in any piece of available ground, with only a small ventilation pillar showing above ground.

The introduction of Class C insulation, which has been used up to the present in ground-mounted air-cooled transformers, has opened out a new line of approach. Consideration of the properties of Class C insulation showed that the high operating temperature could be used to advantage in restricting the dimensions of the unit, while the fact that the material is non-hygroscopic minimised the difficulties due to dampness. The main problem was the disposal of the cooling air at the operating temperatures which can be used with Class C insulation.

A design for a "buried" type Class C insulated transformer was prepared and manufacture was completed in fifteen months from the conception of the idea. The complete unit consists of a tank suitable for burying direct in the ground, containing a 500 kVA 11 kV/433 V, three-phase transformer core and winding. Both h.v. and l.v. cable end boxes are mounted on the ends of the tank.

The flow of cooling air, which is circulated by natural convection only, is controlled by the overground vent, which is in the form of a street pillar. The cooling air enters by the two lower louvres and is directed to the bottom of the transformer tank; the hot air rising from the transformer is directed through the centre section of the ventilating pillar and is emitted at the top. The length of the transformer tank is 5ft, while the depth of excavation required is 6ft 3in. As the tank is only 2ft 4in wide it can be installed in narrow footpaths.

During a works test the transformer carried a continuous load of 500 kVA



Ferranti "buried" type transformer with Class C insulation

successfully while buried. Under normal load cycle conditions the top of the ventilating pillar averaged blood heat. This transformer has just been put into operation at Canniesburn, near Glasgow.

Batti-Wallahs' Society

The last luncheon of the year of the Batti-Wallahs' Society was held at the Connaught Rooms, London, last week, and no better speaker than Mr. J. R. Rylands (director and chief engineer, E. Green & Son, Ltd.) could have been chosen to wind up the year. He gave a delightful and witty talk on "Odd Moments" in his career, particularly during his stay in the Gold Coast as chief engineer of one of the mining companies, from which he drew certain morals. Mr. W. C. M. Couch (past-president) introduced the speaker in the absence through indisposition of Dr. L. G. Brazier, and Mr. R. H. Gummer proposed a vote of thanks.

Financial Section

STOCKS and SHARES

DECEMBER began with Stock Exchange activity at a minimum and without any definable trend in prices. Barring unexpected developments, it begins to look as though most industrial shares will end the year at prices not greatly different from those ruling twelve months ago. The market has maintained its recovery from the worst effects of the events leading up to September's increase in bank rate, but the net decline is still at least equal in extent to the rise accomplished in the first part of the year. It is hoped that the launching of the British Petroleum Company's big capital issue will shortly remove one factor which for some time has been acting as a restraint on investment business.

Price Changes

Although very quiet, the electrical equipment market has not been without good features. On Automatic Telephone new ordinary shares, offered at 52s 6d, the premium rose by 2s to 5s 9d before the first call of 20s per share became due for payment yesterday (Thursday). The old shares advanced to 57s 6d. Ericssons also improved, to 20s 3d. C. A. Parsons rose a further 1s 3d, to 52s 6d, on the strength of the reported Italian order from the Nuclear Power Plant Co. With the interim dividend declaration due, Vactric gained 2s to 18s 3d. An equally sharp rise in Decca "A", to 26s 3d, was associated with reports of flourishing business in gramophone records. E.M.I at 28s 9d reflected the same factor. A.E.I. and G.E.C. both declined by 1s or so, but there were improvements elsewhere in Taylor Tunnicliff, Telephone Rentals, Chloride Electric, Burco and Aerialite. Holophane at 12s 9d were quoted ex the two-for-three scrip issue.

Brook Motors Results

There was a good response from Brook Motors 10s shares to the company's preliminary statement on the results for the year ended in September. These satisfied well the expectations raised by the interim report issued in May. The price of the shares was marked up officially from 32s 6d to 33s 9d, and rather higher than that in the market. Final figures are not yet available, but they will show a profit of not less than £750,000, before tax. This is double the previous year's earnings, which had been considerably affected by the fall in raw material prices as well as by a temporary dislocation in production. A final distribution of 20 per cent is to be made in the form of a second interim dividend which will make a total of 25 per cent, the same as for last year. It is taking longer than previously to complete the accounts because of the group's increasing business in North America.

Record Changers

A recent jump of about 5s to 27s 6d, in the 5s shares of Birmingham Sound Reproducers (makers of the "Monarch" record changer and other gramophone equipment) calls attention to one of the most successful of this year's new issues. It was only last May that the shares were marketed in the Stock Exchange at not much more

Price Changes in

Company or Board	Nom. Value	Middle price 2nd Dec.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
						£ s d		
Gilt-edged Stocks								
Brit. Elec. 1968/73	100	71½		3	3	4 4 0	80	70
Brit. Elec. 1974/77	100	68		3	3	4 8 3	78½	66
Brit. Elec. 1976/79	100	71		3½	3½	4 18 6	81½	70
Brit. Elec. 1974/79	100	82	+½	4½	4½	5 3 9	92½	79½
Overseas Electric Supply								
Calcutta Elec.	£1	16/-		6†	6·8†	8 10 0†	19/-	15/-
East African Power	£1	20/-		7	7½	7 10 0	21/-	19/-
Nigerian Elec.	£1	16/6		10	10	12 2 6	18/6	16/6
Perak Hydro-Elec.	£1	16/-		10	12½	15 12 6	18/-	13/3
Electrical Shares								
Aberdare Cables	5/-	10/3		17½	17½	8 10 9	12/-	9/9
Aerialite	1/-	6/-	+6d	48	51½	8 11 9	6/9	4/9
Allen, W. H.	£1	35/-		10	10	5 14 3	47/3	33/6
Anglo-Portuguese Tel.	£1	21/9		8	8	7 7 3	27/6	20/6
Aron Elec. Ord.	£1	55/-		15	15	5 9 0	60/-	53/6
Assoc. Elec. Ord.	£1	50/-xd	−1/-	15	15	6 0 0	73/-	49/6
Automatic Tel. & El.	£1	57/6	+2/6	15	17	5 18 3	75/-	54/6
Babcock & Wilcox	£1	60/9	+9d	15	15	4 18 9	82/6	54/9
Bakelite	10/-	21/3		16	15	7 1 3	24/6	20/9
Baldwin, H. J.	2/-	4/-		20	20	10 0 0	5/-	3/10½
Berry's Electric	5/-	6/-		—	10	8 6 9	6/6	5/6
British Aluminium	£1	42/-		12	12	5 14 3	71/3	38/9
Brit. Elec. Traction: Def. Ord. "A"	5/-	19/-		22½	25	6 11 6	25/-	17/-
B.I. Callender's	£1	41/9xd		12½	12½	5 19 9	55/-	40/9
B.I. Callender's 6% Pref.	£1	20/-		6	6	6 0 0	21/9	19/-
British Tabulating	£1	40/-		9	9	4 10 0	56/3	37/6
British Thermostat	5/-	21/3		25	25	5 17 9	27/6	22/6
British Vac. Cleaner	5/-	5/-		15	10	10 0 0	8/-	5/-
Brook Motors	10/-	33/9	+1/3	25	25	7 8 3	37/6	30/-
Bulgin, A. F.	1/-	4/9		50	40*	8 8 6	5/6	4/-
Burco Dean	5/-	13/9	+6d	22½	20	7 5 6	14/-	8/9
Cable & Wireless: Ord.	5/-	10/-	−3d	10	10	5 0 0	12/6	9/6
4% Loan	100	90½xd		4	4	4 8 6	92½	89
Chloride El. Storage "A"	£1	60/-	+1/3	17½	17½	5 16 9	68/9	55/9
Clarke Chapman	£1	140/-		22½	27½	3 18 6	9	5⅞
Cole, E. K.	5/-	17/3		17½	17½	5 1 6	23/6	16/6
Cossor, A. C.	5/-	5/3		Nil	2½	2 7 6	7/3	5/-
Crabtree	10/-	24/3	+6d	20	20	8 5 0	26/-	23/3
Crompton Parkinson Ord.	5/-	15/-		16	16	5 6 9	17/9	14/-
De La Rue	5/-	23/-xd		30	35	7 12 3	24/9	16/3
Decca "A"	4/-	26/3	+2/-	43⅜	43⅜	6 13 3	32/3	22/-
Desoutter	5/-	31/6		30	32½	5 3 3	35/6	27/6
Dewhurst	2/-	7/- xd		16½	20	5 14 3	7/9	5/9
Dictograph Tel.	2/-	5/9		20	20*	6 19 3	6/3	5/3
Dubilier Condenser	1/-	3/6		30	30	—	8/1½	3/3
Duport	5/-	18/3xd	+3d	25	25	6 17 0	21/-	17/-
E.M.I.	10/-	28/9	+9d	15	15	5 4 3	36/-	23/9
Electrical Components	5/-	7/3		25	12½*	8 12 6	8/-	6/6
Elec. Construction	£1	23/9		8½	8½	7 3 3	27/6	21/9
Elliott-Automation	5/-	12/6		—	10‡	4 0 0	12/6	10/3
Enfield Cable Ord.	£1	13/9	−3d	Nil	Nil	Nil	21/6	13/-
English Electric	£1	50/-	−1/3	12½	14	5 12 0	65/-	47/6
English Electric 3¾% Pref.	£1	12/3		3¾	3¾	6 2 6	14/3	11/3
Ericsson Tel.	5/-	20/3	+9d	20†	22†	2 14 3*†	25/-	17/-
Ever Ready	5/-	15/-		35	37½	6 5 0*	20/-	14/3
Falk Stadelmann	£1	36/3		17½	17½	9 13 0	40/6	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

than one-third of their present price. At the time of the introduction, the prospectus estimated profits of not less than £350,000 for the current year (ending in December) and forecast a total dividend of 20 per cent, including an interim of 7½ per cent. In the event the interim payment declared in October proved to be 15 per cent. It was accompanied by a statement reporting a 50 per cent increase in the rate of record changers produced, also the need for a further increase in output to meet demands, and the expectation that this year's profits will be a good deal larger than the earlier estimates. The final dividend declaration will be due next May.

Electrical Investments

Company or Board	Nom. Value	Middle price 2nd Dec.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1957 Highest	1957 Lowest
Electrical Shares—continued								
G.E.C. Ord.	£1	40/-	−1/3	14	12½	6 5 0	58/9	38/9
G.E.C. 6½% Pref.	£1	20/9		6½	6½	6 5 3	23/6	19/6
General Cables	5/-	12/6		30	30	12 0 0	15/6	11/6
Greenwood & Batley	£1	47/6	+6d	17½	17½	7 7 3	51/3	45/3
Hackbridge Holdings	5/-	11/9		30	20	8 10 3	21/9	11/3
Hackbridge & Hewittic	5/-	11/3xd	+1/6	23	20	8 17 9	16/-	10/-
Head Wrightson	5/-	18/6		20	22½	—	24/3	16/6
Heatrae	2/-	4/9		15	15	6 6 6	4/9	4/-
Henley's	10/-	11/6		11½	11½	10 0 0	17/-	11/3
Holophane	5/-	12/9xc		30	37½	8 16 6*	15/9	10/3
Hoover	5/-	33/-		50	50	7 11 6	44/-	24/9
I.C.I.	£1	38/-		10	10	5 5 3	46/6	36/3
Intl. Combustion	5/-	21/-		20	22½	5 7 3	30/-	19/3
Johnson & Phillips	£1	19/6	+9d	15	10	10 5 0	34/6	18/9
Lancashire Dynamo	£1	33/9		11	11	6 10 3	45/9	33/6
Laurence, Scott	5/-	14/3		15	15	5 5 3	19/9	13/9
Lister, R. A.	£1	25/9	+9d	10	10	7 15 3	33/9	23/3
London Elec. Wire	£1	41/3		12½	12½	6 1 3	53/9	40/9
Lucas, J.	£1	29/3		7½	7½	5 2 6	36/6	27/6
Marconi Marine	£1	31/-	−3d	10	10	6 9 0	37/-	31/-
Marryat & Scott	2/-	10/6		30	35	6 13 3	13/-	8/-
Mather & Platt	£1	47/6		15	15	6 6 3	63/9	47/-
Metal Industries	£1	22/9	−6d	Nil	9	7 18 3	30/-	20/3
Midland Elec. Mfg.	£1	47/6		12½	12½	5 5 3	52/6	45/-
Morphy-Richards	4/-	15/-		50	20*	5 6 9	20/-	11/6
Murex	£1	58/3		20	20	6 17 3	79/6	58/3
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/1
Oldham & Son	1/-	2/6xd		17½	17½	7 0 0	3/-	2/3
Parnall (Yate)	5/-	6/3		12	12	9 12 0	8/9	5/9
Parsons, C. A.	£1	52/6	+1/3	8½	7½*‡	—	71/3	45/-
Plessey	10/-	62/6xd	−9d	30	30	4 16 0	86/3	61/-
Pye "A" Deferred	5/-	13/9		12½	12½	4 11 0	20/-	12/-
Reyrolle	£1	77/6		16½	17½	4 10 3	110/-	72/-
Rheostatic	4/-	7/9		18½	12½*	6 9 0	10/-	7/-
Richardsons Westgarth	5/-	14/6xd		16¾	16¾	5 15 0	20/-	13/6
Scottish Cables	4/-	13/3		27½	27½	8 6 0	19/3	13/3
Simon-Carves	5/-	23/9		28¾	20*	4 4 3	36/3	23/9
Smith (England), S.	4/-	14/6		17½	20	5 10 3	16/-	12/9
Southern Areas	£1	11/3		7½	7½	13 16 9	20/-	11/3
Strand Elec.	5/-	6/3		15	15	12 0 0	8/-	5/9
Sturtevant	5/-	18/3	+6d	15†	15†	4 2 3†	27/-	18/-
Sun Elec.	£1	43/9xd		25	25	11 8 6	45/-	42/-
Switchgear & Cowans	5/-	9/9		25	25	12 16 3	15/6	9/9
Taylor Tunnicliff	5/-	12/9	+6d	15	15	5 17 9	13/9	11/9
T.C.C.	10/-	37/6		25	25	6 13 3	41/3	35/-
T.C. & M.	£1	24/6		8½	8½	6 18 9	31/-	24/-
Telephone Mfg.	5/-	5/6	+3d	10	10	9 1 9	8/-	5/3
Telephone Rentals	5/-	10/-	+6d	12½	12½	6 5 0	12/6	9/6
Thompson (John)	5/-	25/-		25	25	5 0 0	37/-	23/6
Thorn Elec.	5/-	20/-	−9d	15	17½	4 7 6	26/3	16/3
Thornycroft	£1	27/6	+1/-	12½	12½	9 1 9	37/6	21/3
Tube Investments	£1	54/9	−6d	13¾	15	5 9 6	70/-	51/3
Vactric	5/-	18/3	+2/-	17½	25	6 17 0	23/9	12/9
Veritys	5/-	7/-		12½	12½	8 18 6	9/3	7/9
Walsall Conduits	4/-	11/6	+3d	20	20	6 19 3	15/-	11/-
Ward & Goldstone	5/-	26/-xd	−9d	35	40	3 17 0*	29/-	18/6
Watford	2/-	5/9		25	25	8 13 9	6/9	5/9
Westinghouse	£1	32/-	−3d	18	9‡*	5 12 6	41/3	28/9
West, Allen	5/-	10/3		15	15	—	13/6	9/6
Wolf Electric	5/-	9/-		20	20	5 11 0*	13/9	8/9

Radio Rentals

The financial year of Radio Rentals ended last August, and the results are expected to be made known within a week or two. A recent improvement to 31s in the price of the 5s ordinary shares, which stood under 23s earlier this year, suggests the anticipation of good figures. For many years the company has been reporting regular and substantial improvements in earnings, of which by far the greater part has been retained for the expansion of the business while the balance has provided shareholders with an increasingly good return. Last year's distribution, equivalent to 22½ per cent on the present capital of £898,000, was covered almost five times over by the available surplus. The interim dividend for the latest period was 7½ per cent, against the previous corresponding payment of 10 per cent on half the present capital, which was subsequently doubled by a scrip issue.

Dewhurst & Partner

The preliminary statement of the annual results made recently by Dewhurst & Partner showed a continuation of the expansion which has been in progress with almost no interruption since the company was made public in 1948. In the interval shareholders have received a rising income return from their investment, while the reserves have been built up on a scale permitting two capitalisation issues, one of 200 and the other of 100 per cent. For the latest period, ended in September, the net profit (after a substantially higher tax charge of £157,000) has further advanced by about one-fifth to £149,000. The dividend for the year is being raised from 16¼ to 20 per cent, and still appears to leave more than two-thirds of the available surplus to go back into the reserves. At 7s x.d. the 2s ordinary shares are on a yield basis of about 5¾ per cent, which reflects the sound investment status accorded to them.

Hackbridge & Hewittic

Hackbridge & Hewittic 5s shares have recovered well from about 10s to 11s 3d since the declaration of a 5 per cent interim dividend, as before, and the accompanying progress report covering the first half of the year ending next March. Net profits for the six months are given as £191,000, against £185,000 for the same half of the previous year, and for the full period the trading results are expected to be better than those of 1956–7. In the latter period profits suffered from rising costs and consequently smaller margins, and the dividend was reduced from 23 to 20 per cent. The report spoke of records in orders received, and of benefits still to come from the expansion of manufacturing facilities.

REPORTS and DIVIDENDS

Brook Motors, Ltd., in a preliminary statement, report that the group profit, before taxation, for the year to 30th September last will not be less than £750,000, as compared with £370,732 for 1955-56. A second interim dividend of 20 per cent is declared, making 25 per cent for the year. A similar distribution was made for the preceding year, but the interim dividend of 5 per cent was paid on capital before a rights issue. The directors state that the company has at present two subsidiaries operating in the United States and it is contemplated that further overseas subsidiary companies may be formed in the near future. With the increased sales in North America it has become difficult to complete the group accounts in time for the report and accounts to be issued for an annual meeting in December, and accordingly it is proposed to hold the meeting on 25th January.

Efco, Ltd., has announced an interim dividend of 5 per cent (against 4 per cent) on larger capital. It is stated that the increase does not indicate that the total dividend for the year will be larger.

The British Electric Resistance Co., Ltd., announces that in view of the continued rise in turnover and in anticipation of increased capital requirements, it proposes to double its capital to £200,000 by creating a further 1,000,000 2s shares.

Associated Electrical Industries, Ltd., has announced a third interim dividend of 2½ per cent (unchanged).

Berry's E'ectric Magicoal, Ltd., is paying an unchanged interim dividend of 4 per cent.

Bakelite, Ltd., has announced an interim dividend of 5 per cent (unchanged).

The London Electrical & General Trust, Ltd., has declared an interim dividend of 4 per cent (unchanged).

The Hackbridge & Hewittic Electric Co., Ltd., is paying an interim dividend of 5 per cent (unchanged).

Belliss & Morcom, Ltd., have declared an interim dividend of 4 per cent (unchanged).

The Lisbon Electric Tramways, Ltd., is paying an interim dividend of 2 per cent (against 2½ per cent), tax free.

New Companies

A. P. Besson & Partner, Ltd.—Registered 20th November. Capital £10,000. General electrical, electronic and mechanical engineers, and contractors, etc. H. H. Duckworth and A. P. Besson are permanent directors. Regd. office: c/o Leonard G. Lane, Scotton & Co., 34/46, Ludgate Hill, E.C.4.

Autodevices, Ltd. — Registered 14th November. Capital £1,000. Manufacture and deal in automatic control panels and control gear generally, including switches, switch and wall plugs, transformers, thermostats, etc. Directors: J. A. Garland and Margaret L. Taylor. Regd. office: 35, Hartington Road, West Ealing, W.13.

Bradleys (Swinton), Ltd.—Registered 13th November. Capital £100. Manufacturers of and dealers in electrical apparatus, machinery, appliances and components thereof, etc. Directors: E. T. Bradley and Mrs. Mary Bradley. Regd. office: 42, Kennedy Street, Manchester, 2.

Brayhead Electrical, Ltd.—Registered 14th November. Capital £10,000. Electrical, radio, television, electronic, illumination and mechanical engineers, etc. Directors: W. Murphy and H. T. Mote. Regd. office: Elm Park Court, Pinner, Mdx.

Uppington Tele-Radio (Bristol), Ltd.—Registered 13th November. Capital £1,000. Manufacturers of and dealers in radio and television sets, etc. Joan G. Uppington is the first director. Regd. office: 12, Pennywell Road, Bristol, 2.

J. E. Sexton, Ltd.—Registered 14th November. Capital £100. Electronic, electrical, radio and other goods manufacturers and dealers, etc. J. E. Sexton is the first director. Regd. office: 289/293, High Holborn, W.C.1.

Electronic Measurements, Ltd.—Registered 21st November. Capital £100. Electronic and automation engineers, etc. Directors: C. R. Banks and W. T. Johnson. Regd. office: 113, Kingsway, W.C.2.

Bankruptcies

C. H. Marshall, 31, Lombard Street, Newark-on-Trent, Notts, electrical contractor, and **J. G. Hallam,** 7, Grassthorpe Road, Sutton-on-Trent, electrical contractor, carrying on business at 13, High Street, and Farholme Lane, Sutton-on-Trent, and at 18, Eldson Street, Tuxford, formerly carrying on business in partnership as Marshall & Hallam at the above mentioned places of business.—Receiving order made 19th November on debtors' own petition. Public examination 6th February at the Court House, St. Peter's Gate, Nottingham.

A. King, 6, Beresford Square, Woolwich, S.E.18, radio and electrical dealer.—Order of 7th June, 1943, refusing discharge reviewed on 3rd October last and order made suspending discharge for nine months until 3rd July, 1958, subject to payment to the Official Receiver by debtor of £70 within seven days for distribution among creditors (£70 duly received).

A. Le'N. Williamson, Sandringham Hotel, Hope Road, Shanklin, I. of W., hotel proprietor and electrical engineer.—Trustee, Mr. R. G. B. Booth, 21, The Avenue, Southampton, released 12th November.

R. Corbett and **I. A. J. Merritt,** carrying on business under the style of Corbett & Merritt at 2b, Junction Road, Andover, Hants, electrical and radio engineers.—Last day for receiving proofs for dividend 6th December. Trustee, Mr. A. H. Horler, 54, Endless Street, Salisbury, Official Receiver.

O. E. Harford, Mount Charles Road, St. Austell, Cornwall, electrical contractor and dealer.—Receiving order made 22nd November on debtor's own petition.

C. E. Purcell, 81, Addison Road, London, W.14, electrical contractor, lately residing at 13, Wrotham Road, Gravesend, Kent, and carrying on business at 13, Wrotham Road, Gravesend, under the style of Edward Purcell & Son.—First meeting 6th December at the Official Receiver's office, 280a, High Street, Rochester. Public examination 9th January at the Court House, Eastgate, Rochester.

L. Myers, 320, Rochdale Road, Collyhurst, Manchester, electrical wholesaler.—Trustee, Mr. J. A. Freeman, 8, Manchester Road, Bury, appointed 20th November.

D. Campbell-Kerr, East Street, Mayfield, Sussex, formerly carrying on business under the style of Warren Electrical Co., as an electrical engineer.—Trustee, Mr. T. H. Parker, 8, Old Steine, Brighton, 1, Official Receiver, released 20th November.

J. R. Short, c/o 23, Primrose Street, South Hylton, near Sunderland, and formerly carrying on business at 11, Rutland Avenue, Bishop Auckland, electrical contractor.—Last day for receiving proofs for dividend 10th December. Trustee, Mr. N. Saddler, Clarendon House, Clayton Street West, Newcastle-upon-Tyne, 1, Official Receiver.

D. Beck, formerly carrying on business at 96, Harris Street, Bradford, and lately carrying on business under the name of Electrical and Hardware Appliances and residing at "Kebroyd," Ings Lane, Guiseley, Yorks.—Last day for receiving proofs for dividend 9th December. Trustee, Mr. J. L. Williams, 3rd Floor, Pearl Chambers, East Parade, Leeds, 1, Official Receiver.

Scottish Lighting Conference

BETTER street lighting would play a vital part in cutting down road accidents, claimed Mr. W. Robinson (Electrical Development Association) when he addressed the annual meeting of the Scottish Section of the Association of Public Lighting Engineers. Mr. Robinson, whose subject was "Street Lighting To-day," urged that more should be spent on street lighting in view of the increasing number of casualties at night.

To-day, said Mr. Robinson, the cost of street lighting was equivalent to a box of matches per person per week and the cost of the electricity for it was equivalent to each house putting in an extra 60 W lamp. Street lighting deserved a better slice of the national and local cake. The Government, it was true, was hamstrung by economic troubles, but the axe always seemed to fall first on new lighting projects.

Putting forward an opposite view, Mr. J. Brodie, Ayr, said that after better street lighting had been installed in that burgh the number of accidents had increased. Motorists were inclined to travel faster and the pedestrians jay-walked.

Mr. Robinson said he could not accept that view. If they improved the lighting sufficiently there was evidence that this would substantially reduce road mishaps at night.

Mr. J. W. Moule, chief commercial officer, South of Scotland Electricity Board, discussing tariffs, said they were charging less than they should for street lighting. His Board last year had incurred a loss on street lighting.

Mr. H. Carpenter, Blackpool, the national president, said he thought the pendulum was swinging a little too far in the quest for efficiency at the expense of quality.

Mr. T. M. Lappin, Dundee, Scottish chairman, presided over the conference, which was attended by more than 100 lighting engineers and delegates from local authorities.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 9th December

CARDIFF.—At the South Wales Institute of Engineers, 6 p.m. I.E.E. Western Centre. "138 kV Submarine Power Cable Interconnection between the Mainland of British Columbia and Vancouver Island," by Dr. T. Ingledow, R. M. Fairfield, E. L. Davey, K. S. Brazier and J. N. Gibson.

HANLEY.—Town Hall, 7 p.m. I.E.E. North Staffordshire Sub-Centre. "Cathodic Protection," by L. B. Hobgen, K. A. Spencer and P. W. Heselgrave.

LEEDS.—At the Lighting Service Bureau, 24, Aire Street, 6.15 p.m. I.E.S. Leeds Centre. "Turning Day into Night—Some Interesting War-time Secrets," by C. H. Wood.

LIVERPOOL.—At the Royal Institute, Colquitt Street, 6.30 p.m. I.E.E. Mersey and North Wales Centre. "Electrical Equipment for Rectifier Locomotives," by H. B. Calverley, E. A. K. Jarvis and E. Williams.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Informal meeting. Discussion on "Where Should Research End and Development Start?", opened by Dr. K. J. R. Wilkinson.

White Hall Hotel, Bloomsbury Square, W.C.1, 6.30 p.m. A.S.E.E. Central London Branch. Seasonal get-together.

NEWCASTLE-UPON-TYNE. — Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. "D.C. Winder Drives Using Mercury-Arc Rectifier/Invertors," by L. Abram, J. P. McBreen and J. Sherlock.

SHEFFIELD. — Grand Hotel, 7.15 p.m. Institution of Production Engineers, Sheffield Section. "High Production with Automation Arc Welding," by J. A. Lucey.

WEMBLEY PARK.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North West London Branch. "The Physical Aspects of Electricity," by S. J. Emerson.

Tuesday, 10th December

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. "Factors in the Utilisation of Electrical Power in Aircraft," by H. Zeffert.

BIRMINGHAM. — Birmingham College of Technology, Costa Green, 7 p.m. Institution of Works Managers, Birmingham Branch. "Electronics, the Way Ahead," by R. B. Smith.

CHELMSFORD. — Public Library, 7 p.m. I.E.E. London Graduate and Student Section. District meeting. "Television Film Recording," by E. J. Stocks.

DONCASTER.—Danum Hotel, 7.15 p.m. Institution of Production Engineers, Doncaster Section. "The Production of Fractional Horsepower Motors."

EDINBURGH. — Scottish Lyceum Gallery and Restaurant, 11, Atholl Crescent, 7.30 p.m. Edinburgh Electrical Society. "Electrical Equipment for Welding."

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. Informal evening on "Electronics and Automation," by H. A. Thomas.

GREENWICH. — Telcon Works, 7 p.m. P.O.A. South East London Branch. Film. "First Transatlantic Telephone Cable."

HATFIELD. — Technical College, 7 p.m. I.E.E. District meeting. "Circuit-Breaker Testing," by J. G. P. Anderson.

HULL. — Y.E.B., Ferensway, 6.30 p.m. I.E.S. Leeds Centre. "Commercial and Industrial Lighting," by J. C. Harcourt.

LEEDS.—C.E.A., 1, Whitehall Road, 7 p.m. I.E.E. North Midland Graduate and Student Section. "An Airing of Controversial Issues."

LONDON.—At the Federation of British Industries, 21, Tothill Street, S.W.1, 6 p.m. Illuminating Engineering Society. "T.V. Studio Lighting Equipment," by K. R. Ackerman.

Connaught Rooms, 12.30 for 1 p.m. Electrical Industries Club. Christmas luncheon.

Institute's House, 5.30 p.m. Institute of Physics, Electronics Group. "Infra-red and Microwave Modulators using Free Carriers in Germanium," by Dr. A. F. Gibson.

PORTSMOUTH.—Wiltshire Lamb Hotel, 7.30 p.m. A.S.E.E. Portsmouth Branch. "Installation and Operation of a Television Station," by E. P. D. Metcalfe.

PRESTON.—Chamber of Commerce, Fishergate, 7.30 p.m. P.O.A. North Lancs. Branch. Film. "Calder Hall Power Station," and address on "Recent Trends and Developments in Electricity Generation," by E. A. Scholes.

RUGBY.—College of Technology and Art, 6.30 p.m. I.E.E. Rugby Sub-Centre. "Mechanical Strength of Power Transformers in Service," by E. T. Norris.

YORK.—Royal Station Hotel, 7.30 p.m. A.S.E.E. York Branch. "Floor Warming," by J. Sanderson.

Wednesday, 11th December

BIRMINGHAM.—James Watt Memorial Institute, 6.30 p.m. I.E.E. South Midland Graduate and Student Section. Senior chairman's address, by L. L. Tolley.

Birmingham Exchange and Engineering Centre, Stephenson Place, 7.30 p.m. A.S.E.E. Birmingham Branch. Film: "The Golden Age."

BLACKBURN. — N.W.E.B., Jubilee Street. I.E.E. North Lancashire Sub-Centre. "The Measurement of Earth-loop Resistance," by Dr. G. F. Tagg.

CARDIFF.—Angel Hotel, 7 p.m. Plastics Institute, South Wales and Monmouthshire Section. "Use of Rubber and Plastics in the Cable Industry," by K. H. Whitlock.

GLASGOW.—207, Bath Street, 7 p.m. Institute of Physics, Scottish Branch. "Lord Kelvin," by Prof. P. I. Dee.

HALIFAX.—Crown Hotel, Horton Street, 7.45 p.m. A.S.E.E. Halifax Branch. "Plastic Electric Cables—Developments and Applications," by W. T. A. Cheshire.

LEEDS.—Metropole Hotel. Combustion Engineering Association, Leeds Branch. 10.30 a.m., "The Burning of Difficult Fuels," by E. J. MacDonald. 2.30 p.m., "Methods of Smoke Measurement and Control," by G. Nonhebel.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio and Telecommunication Section. "A Flying-Spot Film Scanner for Colour Television," by H. E. Holman, G. C. Newton and S. F. Quinn.

Grosvenor Hotel, Victoria, S.W.1, 5.45 p.m. Engineers' Guild. Annual general meeting.

LUTON.—Luton and Dunstable Chamber of Commerce, George Street West, 8 p.m. A.S.E.E. Luton Branch. "Applications of Ultrasonics," by O. Roberts.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. I.E.E. North-Western Radio and Telecommunication Group. "Ferrites," by Dr. D. H. Pringle.

N.W. Electricity Board Showrooms, Town Hall Extension, St. Peter's Square, 7 p.m. I.E.E. North Western Graduate and Student Section. Annual film evening.

NEWCASTLE-UPON-TYNE.—At the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, 6 p.m. British Institution of Radio Engineers, North Eastern Section. "Stereophonic Sound and Tape Recorders," by D. H. McBean.

NORTHAMPTON.—College of Technology, 7.15 p.m. Northampton and District Electrical Association. "Electrical Engineering in the Steel Tube Industry," by Major H. E. Knight.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "Mechanical Strength of Power Transformers in Service," by E. T. Norris.

Thursday, 12th December

BARROW.—N.W.E.B., Duke Street. I.E.E. North Lancashire Sub-Centre. "The Measurement of Earth-loop Resistance," by Dr. G. F. Tagg.

CHATHAM.—Sun Hotel, 7.30 p.m. Institution of Production Engineers, Rochester Section. "The Practical Uses of Electronics in Industry," by K. A. Zandstra.

DUNDEE.—Electrical Engineering Department, Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33 kV and Above," by A. Morris Thomas and D. F. Oakeshott.

GLASGOW. — Scottish Building Centre, Sauchiehall Street, 7.15 p.m. Incorporated Plant Engineers, Glasgow Branch. "Electric Arc Welding," by J. W. Macfarlane.

LIVERPOOL.—Exchange Hotel, 7.15 p.m. Incorporated Plant Engineers, Merseyside and N. Wales Branch. "Heating and Ventilation," a discussion led by H. S. Crump.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilisation and Radio Sections. "Electrical Control of Stage and Television Lighting," by F. Bentham. (Joint meeting.)

MANCHESTER. — College of Technology, Sackville Street, 6.30 p.m. British Institution of Radio Engineers, North Western Section. "Process Heating," by M. O'C. Horgan.

NORTHAMPTON. — Grand Hotel, 7 p.m. I.E.E. Rugby Graduate and Student Section. "Hydrogen Cooled Alternators," by J. A. Pownall.

SOUTHAMPTON.—Polygon Hotel, 7.30 p.m. I.E.E. Southern Centre. Annual dinner and dance.

SWANSEA. — Conference Rooms, South Wales Electricity Board Showrooms, The Kingsway, 6 p.m. I.E.E. West Wales (Swansea) Sub-Centre. "Cathodic Protection," by L. G. Hobgen, K. A. Spencer and P. W. Heselgrave.

WIMBLEDON.—Prince of Wales Hotel, 7.45 p.m. A.S.E.E. South West London Branch. "Electricity in the Gas Industry," by H. F. Buxton.

Friday, 13th December

ABERDEEN.—Robert Gordon's Technical College, 7.30 p.m. I.E.E. North Scotland Sub-Centre. "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33 kV and Above," by A. Morris Thomas and D. F. Oakeshott.

BIRMINGHAM.—Regent House, St. Philip's Place. Society of Instrument Technology, Midlands Section. "Electronic Instrumentation, Trends and Implications," by R. J. Redding (Evershed & Vignoles, Ltd.).

LEICESTER.—College of Technology, 7.15 p.m. I.E.E. East Midland Centre. "Highland Water Power—The Developments of the North of Scotland Hydro-Electric Board," by the late T. Lawrie, to be read by a member of the Board.

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Basic Experiments on Servo Mechanisms," opened by W. Chellingsworth.

Caxton Hall, Westminster, 6.30 p.m. E.P.E.A. Southern Meter Engineers' Technical Group. "A New Meter for the kVA Demand Charge," by P. Baxter.

Pepys House, 14, Rochester Row, Westminster, S.W.1, 7.30 p.m. Junior Institution of Engineers. Presidential address.

SWANSEA.—Langland Bay Hotel, Mumbles, 7 for 7.30 p.m. I.E.E. West Wales (Swansea) Sub-Centre. Annual dinner and dance.

Saturday, 14th December

MANCHESTER. — College of Science and Technology, 6.45 for 7.15 p.m. Manchester Association of Engineers. Conversazione and dance.

OXFORD.—Regent's Park College, Pusey Street, 7 p.m. A.S.E.E. Oxford, Reading and Districts Branch. "Low Frequency Furnace Heating."

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable after 11th December from the Patent Office, 25, Southampton Buildings, London, W.C.2

1953

9074. General Electric Co., Ltd.—Rack assemblies for mounting electrical components. 28th April, 1954. (787631.)

10037. Whiteley Electrical Radio Co., Ltd., and Whiteley, A. H.—Loudspeakers and the like. 12th April, 1954. (787424.)

26998. Painton & Co., Ltd.—Electrical plug-and-socket connectors. 12th July, 1954. (Addition to 700999.) (787632.)

27540. Mullard Radio Valve Co., Ltd.—Semi-conductor devices. 4th January, 1955. (787573.)

34468. Edison Swan Electric Co., Ltd.—Indirectly heated cathodes for thermionic valves. 1st December, 1954. (787458.)

1954

4407. Soc. Nouvelle de l'Outillage R. B. V. et de la Radio-Industrie.—Television switching equipments. 15th February, 1954. (787425.)

7931 and 23341. General Electric Co.—Semi-conductor devices. 18th March and 11th August, 1954. (787426 and 787578.)

7982. Minister of Supply.—Radar systems. 24th February, 1955. (787633.)

24601. Philips Electrical Industries, Ltd.—Electro-luminescent elements. 24th August, 1954. (787401.)

27050. Napier & Son, Ltd., D.—Application of electrical surface heating elements. 6th September, 1955. (787581.)

27212. Centre d'Etudes et de Developpements de l'Electronique Cedel.—Electromagnetic deflecting means for cathode-ray tubes. 20th September, 1954. (787642.)

28813. Mackie & Co., Ltd., W., and Munns, S. A.—Speed regulating systems for d.c. electric motors and rotary convertors. 28th September, 1955. (787466.)

30918. Telefonaktiebolaget L. M. Ericsson.—Discharge tubes having a plurality of discharge gaps. 26th October, 1954. (787584.)

32415. General Electric Co., Ltd.—Cathode-ray tubes. 9th November, 1955. (787428.)

32923 and 34821. Robertshaw-Fulton Controls Co.—Electric control devices. 12th November and 1st December, 1954. (787654 and 787586.)

1955

875. British Thomson-Houston Co., Ltd.—Dynamic braking control systems for electric motors. 4th January, 1956. (787652.)

1319. Harrison, W. — Photo-electric trichromatic colorimeters. 30th December, 1955. (Cognate application 36425, 20th December, 1955.) (787589.)

1368. General Electric Co., Ltd.—Interlocked electric switches. 17th January, 1956. (787469.)

2671. General Electric Co., Ltd.—Manufacture of semi-conductor devices. 27th January, 1956. (787591.)

7522. Hackbridge & Hewittic Electric Co., Ltd., and Peters, H. J.—Cubicle for mercury arc rectifier apparatus. 14th March, 1956. (787433.)

9054. Siemens-Schuckertwerke Akt.-Ges.—Selenium rectifiers. 28th March, 1955. (787661.)

9599. Sangamo Weston, Ltd.—Frequency responsive systems. 1st April, 1955. (787664.)

10653. Stone & Co. (Deptford), Ltd., J.—Electromagnetic switches. 6th April, 1956. (787667.)

12862. Juby, C. W., and Reeve, W. J.—Safety device for electrically heated appliances. 13th January, 1956. (787670.)

13034. Marconi's Wireless Telegraph Co., Ltd.—Frequency and phase shifters and modulators for very high frequency electromagnetic waves. 17th February, 1956. (787522.)

13518. Chromatic Television Laboratories, Inc.—Cathode-ray tubes for the reproduction of colour television images. 10th May, 1955. (787409.)

13599. Wolseley Engineering, Ltd., and Drake, R. S.—Insulators for supporting an electric wire fence. 9th May, 1956. (Cognate application 13852, 4th May, 1956.) (787671.)

13712. Soc. Asservelec.—Method and devices for generating low frequencies. 12th May, 1955. (787672.)

14272. Siemens-Schuckertwerke Akt.-Ges.—Insulated electric cables and conductors. 17th May, 1955. (787597.)

17086. Pye, Ltd.—Electric circuits. 12th June, 1956. (787599.)

21995. Standard Telephones & Cables, Ltd.—Travelling-wave tube comprising at least two helices. 29th July, 1955. (787686.)

23974. Philips Electrical Industries, Ltd.—Amplifying and rectifying circuit arrangements. 19th August, 1955. (787691.)

24235. Western Electric Co., Inc.—Electron discharge apparatus of the travelling wave type. 23rd August, 1955. (787692.)

25278. Western Electric Co., Inc.—Stereophonic system. 2nd September, 1955. (787528.)

25850. Standard Telephones & Cables, Ltd.—Coupling arrangement for travelling wave tubes. 9th September, 1955. (787603.)

27364. Siemens & Halske Akt.-Ges.—Coaxial cable transmission systems. 26th September, 1955. (787696.)

29906. Eclairage des Vehicules sur Rail.—Constant voltage and polarity electric current generating equipment. 19th October, 1955. (787529.)

30898. Welch, L.—Electromagnetically actuated spray guns. 2nd August, 1956. (787488.)

31075. Philips Electrical Industries, Ltd.—Electric switch contact arrangement having a movable contact spring adapted to be displaced by a driving member. 31st October, 1955. (787701.)

31724. Felten & Guilleaume Carlswerk Akt.-Ges.—Signalling transmission installation consisting of a deep sea cable without outer armouring and underwater amplifiers incorporated therein. 7th November, 1955. (787702.)

32284. Standard Telephones & Cables, Ltd.—Narrow band discriminator circuit. 11th November, 1955. (787605.)

32788. Philips Electrical Industries, Ltd.—Method of adjusting a klystron to a fixed frequency and a klystron adjusted by this method or suitable for carrying out this method. 16th November, 1955. (787704.)

33840. Hazeltine Corporation.—Colour image reproducing apparatus of the projection type. 25th November, 1955. (787489.)

36829. Mason, O.—Electrical connectors and more particularly ceiling roses. 22nd December, 1955. (787713.)

37106. Western Electric Co., Inc.—Ferroelectric signal recording and reproducing systems and record members therefor. 28th December, 1955. (787444.)

1956

2041. Siemens & Halske Akt.-Ges.—Circuit arrangements for use in telecommunication installations. 20th January, 1956. (787543.)

2257. Westinghouse Electric International Co.—Electric control apparatus. 24th January, 1956. (787610.)

2363. Collins Radio Co.—Circuit for preventing intermodulation interference. 24th January, 1956. (787718.)

5005. Cinema-Television, Ltd.—Cathode-ray tubes. 17th February, 1956. (787721.)

5829. Siemens & Halske Akt.-Ges.—Recording measuring instruments. 24th February, 1956. (787547.)

8357. Commissariat a l'Energie Atomique.—Devices for ensuring an electric contact between rotary parts of an electric machine. 16th March, 1956. (787519.)

9294. Handschin, W.—Electricity supply systems for vehicle lighting and signalling installations. 26th March, 1956. (787723.)

15439. Siemens & Halske Akt.-Ges.—Automatic telephone coin boxes. 17th May, 1956. (787676.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 13th December:—

No. 767,628 (design). Class 7. Domestic electric machines; electric motors (not for land vehicles); dynamos; electric welding machines; electrostatic generators and high voltage generators; and parts. No. 767,629 (design). Class 8. Electric shaving apparatus and parts. No. 767,630 (design). Class 9. A wide variety of electric goods in this Class. No. 767,631 (design). Class 10. Electric hearing aids for the deaf, mercury vapour lamps for surgical or curative purposes; X-ray apparatus and instruments, stands for X-ray apparatus, electro-medical and electro-therapeutic apparatus and instruments, ultra-violet and infra-red apparatus and lamps for use therein, all for surgical, medical, dental or veterinary purposes; electric high frequency apparatus for medical or surgical purposes; and parts. No. 767,632 (design). Class 11. Electrical apparatus and instruments for lighting, heating, cooking, refrigerating, drying and ventilating purposes; electric lamps, carbons for electric lamps, fittings for electric lighting, electric light bulbs; reflectors and shades, all for electric lamps; and parts. No. 767,634 (design). Class 15. Electric musical instruments and parts.—Philips Electrical, Ltd., Century House, Shaftesbury Avenue, W.C.2.

NEONIC. No. 767,724. Class 7. Hand-guided electrically driven tools.—S. N. Bridges & Co., Ltd., Bridges Place, Parsons Green, London, S.W.6.

FRIFRI (design). No. B764,103. Class 9. Electric domestic cooking utensils.—Aro. S.A., Bienne, Switzerland. Address for service, c/o Frank B. Dehn & Co., Kingsway House, 103, Kingsway, London, W.C.2.

DEAC (design). No. 763,372. Class 9. Electric cells and electric batteries and parts.—Deutsche Edison Akkumulatoren Co., G.m.b.H., Frankfurt-am-Main, Germany. Address for service, c/o Edward Evans & Co., 53-64, Chancery Lane, London, W.C.2.

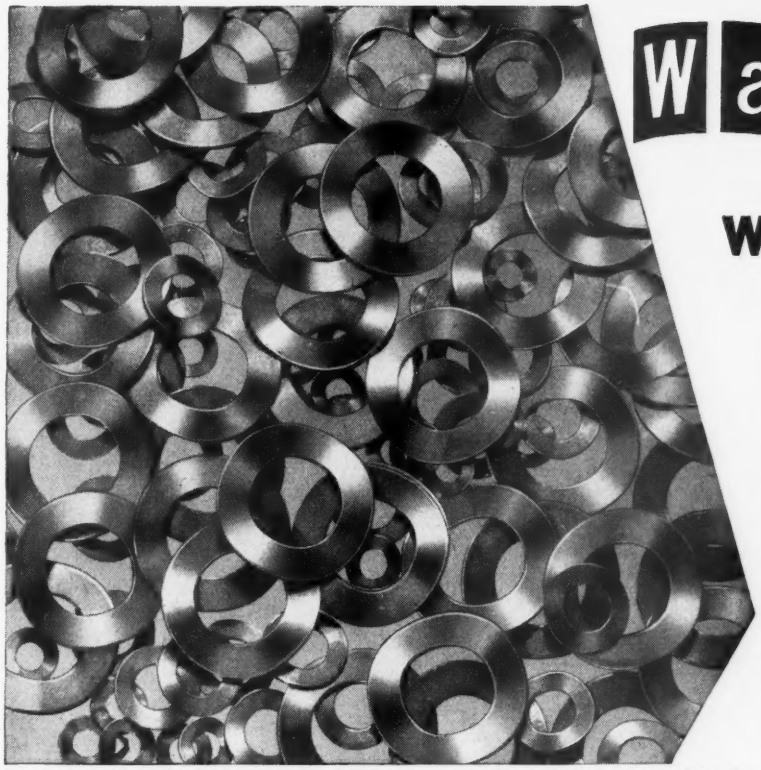
No. 767,515 (design). Class 9. Electrical apparatus and instruments.—P. X. Fox, Ltd., Hawksworth Road, Horsforth, Yorks.

LAMEX. No. 767,327. Class 9. Electrical apparatus for use in automatically controlling the action of machinery or industrial plant.—Metropolitan-Vickers Electrical Co., Ltd., St. Paul's Corner, 1-3, St. Paul's Churchyard, London, E.C.4.

INFINITY. No. 768,437. Class 9. Electric wires insulated with plastics.—Sloan Electrical Co., Ltd., 240-250, Ferndale Road, S.W.9.

No. 762,719 (design). Class 11. Electric lamps and parts.—Osram G.m.b.H., Berlin, Germany. Address for service, c/o Cruikshank & Fairweather, 29, Southampton Buildings, Chancery Lane, London, W.C.2.

HARLEQUIN. No. 761,526. Class 11. Electric lighting fittings and parts, all being goods made of metal, wood or glass.—Troughton & Young (Lighting), Ltd., 143, Knightsbridge, London, S.W.1.



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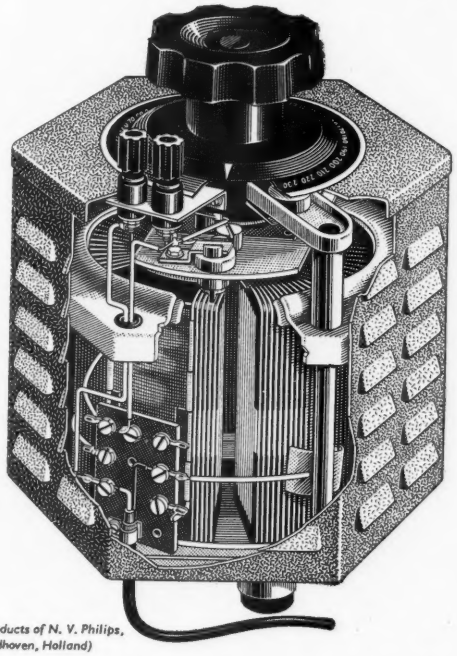

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CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—Electricity Commission of New South Wales, Sydney. 6th January. 33 kV outdoor circuit-breakers and current transformers. (E.S.B. 27861/57. Ten/29412.)*

Department of Civil Aviation, Melbourne. 21st January. Remote control equipment. (E.S.B. 26903/57. Ten/29399.)*

Burma.—Burma Purchase Board, Rangoon. 12th December. Fluorescent lamps. (E.S.B. 28669/57. Ten/29489.)* 16th December. Torches and cells. (E.S.B. 28819/57. Ten/29540.)* Enamelled, cotton and silk covered wire. (E.S.B. 28818/57. Ten/29544.)*

Formosa.—Central Trust of China, Taipei. 7th February. Two 45,000 kW generator sets and power station equipment. (E.S.B. 28387/57.I.C.A. Ten/29436.)* Two 51,000 kW Francis turbines with auxiliaries and spare parts. (E.S.B. 28386/57.I.C.A. Ten/29437.)* 8th February. Two 57,500 kVA power transformers. (E.S.B. 28388/57.I.C.A. Ten/29445.)* 10th February. Power house travelling crane. (E.S.B. 28389/57.I.C.A. Ten/29447.)*

India.—Madhya Pradesh Electricity Board, Nagpur. 16th December. Metering equipment for Korba thermal power station. (E.S.B. 28568/57. Ten/29485.)*

Ministry of Railways (Railway Board), New Delhi. 7th February. 25 kV single-phase a.c. overhead traction equipment. (E.S.B. 28431/57. Ten/29487.)*

Government of Mysore Stores Purchase Committee, Bangalore. 30th April. Two 124,000 b.h.p. turbines with valves and automatic governors. (E.S.B. 28439/57. Ten/29488.)*

Iran.—Organisation du Plan, Teheran. 25th December. Electrical equipment for Tafrech power station. (E.S.B. 28281/57. Ten/29483.)* 30th December. Renewal of distribution network for Roudsar power station. (E.S.B. 28282/57. Ten/29435.)*

New Zealand.—G.P.O., Wellington. 15th January. Switchboard lamps. (E.S.B. 27535/57. Ten/29404.)* 16th January. Junction blocks. (E.S.B. 27924/57. Ten/29410.)* 21st January. Insulator spindles. (E.S.B. 28254/57. Ten/29414.)* Telephone cable. (E.S.B. 28255/57. Ten/29433.)* Micro-ammeters. (E.S.B. 28256/57. Ten/29413.)* 23rd January. Vulcanised rubber tape. (E.S.B. 28449/57. Ten/29451.)* Headphone jacks. (E.S.B. 28442/57. Ten/29452.)* 24th January. Radio pilot lamps. (E.S.B. 28443/57. Ten/29462.)* 27th January. Crocodile clips and miniature toggle switches. (E.S.B. 28444/57. Ten/29449.)*

Nottinghamshire.—County Council. 28th December. Street lighting equipment. (See this issue.)

Philippines.—National Power Corporation, Manila. 29th January. One 55,600 kVA a.c. generator, appurtenances and spares. (E.S.B. 27938/57. Ten/29411.)*

Portuguese East Africa.—Ports, Railways and Transport Department, Lourenço Marques. 13th January. Electrical equipment for power distribution network. (E.S.B. 28792/57. Ten/29568.)*

Rhodesia and Nyasaland.—Federal Tender Board, Causeway. 13th December. Porcelain insulators. (E.S.B. 28474/57. Ten/29491.)* Electronic equipment. (E.S.B. 28476/57. Ten/29479.)*

Southern Rhodesia Electricity Supply Commission, Salisbury. 19th December. Three-phase rural type transformers. (E.S.B. 28273/57. Ten/29408.)*

Romford.—Borough Council. 4th January. Electric lamps for one year. Borough engineer, Town Hall.

South Africa.—Johannesburg City Council. 12th December. Overhead line taps. (E.S.B. 28374/57. Ten/29482.)* Lightning arrestors. (E.S.B. 28371/57. Ten/29420.)* Electricity meters, current transformers and test blocks. (E.S.B. 28376/57. Ten/29422.)* Street lighting control contactors. (E.S.B. 28375/57. Ten/29424.)*

Stores Department, South African Railways, Johannesburg. 18th December. Electric cable. (E.S.B. 28405/57. Ten/29423.)* Electric welding cable. (E.S.B. 28036/57. Ten/29391.)* Automatic telephone exchange. (E.S.B. 28406/57. Ten/29416.)* 20th December. Two-way v.h.f. radio equipment. (E.S.B. 27675/57. Ten/29415.)* Insulators. (E.S.B. 27677/57. Ten/29418.)* 8th January. Three-phase induction motors and starters. (E.S.B. 28408/57. Ten/29470.)* One 6·6 kV 25 MVA switchboard and three remote switches. (E.S.B. 28407/57. Ten/29457.)*

Union Tender and Supplies Board, Pretoria. 19th December. P.v.c. insulated wire. (E.S.B. 28013/57. Ten/29379.)* Bronze and copper sleeves and galvanised steel sleeves. (E.S.B. 28015/57. Ten/29497.)*

Southampton.—Corporation. 20th January. Renewal of electrical installation at Itchen Grammar School. (See this issue.)

Stockport.—Corporation. Applications to tender for mechanical engineering services (heating and ventilation) and electrical installation at College for Further Education should be submitted by 21st December. (See this issue.)

ORDERS PLACED

Dewsbury.—Education Committee. Electrical installation work at Overthorpe County Infants' School (£1,914).—Hammerton & Waring.

Hebburn-on-Tyne. — U.D.C. Electrical installations in 52 houses at Mill Lane (£1,498).—Norman Robinson.

London.—Lewisham Works and Highways Committee. Recommended. Equipment for modernisation of lighting of section of the South Circular Road from Catford Hill to the borough boundary and re-lighting of Verdant Lane: Lanterns and control gear (£2,238).—Engineering & Lighting Equipment Co. Columns (£2,905).—Stewarts & Lloyds. Lamps (£477).—G.E.C. Erection of equipment (£1,967).—O. C. Summers.

Newcastle-on-Tyne. — Regional Hospital Board. Distribution cables and switchgear at St. Nicholas Hospital (£12,031).—Veale Nixon & Co. Electrical installation in operating theatre unit at Bishop Auckland General Hospital (£2,081).—Cox Walker.

Salford.—Transport Committee. Recommended. Rewiring of the electrical installation at Weaste Transport Depot (£7,334).—North Western Electricity Board.

Stoke-on-Trent.—City Council. Recommended. Electrical installation work at Stoke Town Hall (£2,566).—Speed Electric Service (Stoke-on-Trent).

Thornaby-on-Tees.—Corporation. Electrical installations in new houses (£4,380).—Auto-Electrics.

Worthing.—Housing Committee. Rewiring of and additions to electrical installations in 98 houses, Ladydell estate (£1,971).—E. R. Steel.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Abingdon.—College of Further Education; Berks county architect, Wilton House, Parkside Road, Reading.

Ashington.—Four-storey building, hall and assembly rooms at Technical College (£300,000); Middlemiss Bros., Ltd., Stepney Bank, Newcastle-upon-Tyne.

Barnstaple.—Works; Ayres & Grimshaw, Ltd., 3, Bickington Road.

Bexhill-on-Sea.—Block of flats, Albert Road and Marina; Kalck, Ltd., 23, Brandcaster Lane, Purley.

Bexley.—Houses (77), flats (42), and maisonnettes (28), East Wickham estate; borough engineer, West Lodge, Broadway, Bexleyheath, Kent.

Billingham-on-Tees. — Grammar/technical school for Durham C.C.; P. R. Middleton & Partner, architects, 17, Albert Road, Middlesbrough.

Birmingham.—New buildings at Airport (£150,000) for Ministry of Transport and Civil Aviation; Norman & Dawbarn, architects, 7, Portland Place, London, W.1.

Birtley.—Factory and offices; J. Thorn & Sons, Ltd., 164, Brampton Road, Bexleyheath, Kent.

Cambridge.—Fire brigade headquarters at Parkside; county architect, Shire Hall, Castle Hill, Cambridge.

Cannock.—Dwellings (144), Great Wyrley; R.D.C. surveyor.

Canvey Island.—Houses (224), Long Road; Frank P. Smith, Ltd., builders, 4, Chestnut Avenue, Grays, Essex.

Castle Bromwich.—Combined health clinic and library in Hurst Lane (£26,800); G. R. Barnsley, county architect, Shire Hall, Warwick.

Chelmsford.—Shops and offices (five-storey building); Robin Seifert, architect, 28, Great Ormond Street, London, W.C.1.

Coventry.—Rebuilding and reinstatement of fire-damaged portion of Coundon Court Comprehensive School; city architect, Bull Yard.

Croydon.—Shops, showrooms and offices, George Street and Wellesley Street; Norwich Union Insurance Societies, Head Offices, Surrey Street, Norwich.

Cwmbran.—Proposed mental hospital, Llanfrecha Grange (£450,000); Welsh Regional Hospital Board, Architects' Division, Maesycoed Road, Rhiwbina, Cardiff.

Dagenham.—Dwellings (46), Glebe Road; borough engineer.

Dudley.—Houses at Kate's Hill (31), Rosland Farm (59), and ten blocks of flats and bed-sitting rooms, Wren's Nest Road; F. H. Gibbons, borough engineer, Council House.

Durham.—Junior school, West View, Hartlepool; G. R. Clayton, county architect, South Street, Durham.

Secondary modern school at Gilesgate; Newrick & Blackbell, architects, 58, John Street, Sunderland.

Dining rooms and kitchens at South Bailey for Durham University (£19,000); C. Elgey, architect, 7a, North Bailey, Durham.

Edinburgh. — Extensions to bakery (£25,000); D. S. Crawford, Ltd., 29, Frederick Street.

Fife.—Houses (52), Springfield; R. S. Lawrie, county architect, County Buildings, Cupar.

Hamilton.—Thirteen-storey office block in Clydesdale Street (£640,000); D. G. Banner-

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* **Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).**

man, county architect, 34, Albert Street, Motherwell, Lanarkshire.

Haltwhistle.—Houses (40) for the R.D.C.; P. H. Campbell, surveyor.

Harlow.—Factory for Newman & Guardia, Ltd.; David Chaston, Ltd., builders, Essex Road, Hoddesdon.

Haverfordwest.—Engineering depot and garage, Hawthorn Rise, for Ministry of Works; Architects' Department, Abell House, John Islip Street, London, S.W.1.

London.—Headquarters building in Long Lane and Aldersgate Street; London Salvage Corps (Fire), 64, Watling Street, E.C.4.

Offices, 59/65, Gracechurch Street, E.C.; Whinney, Son & Austen Hall, architects, 37, Norfolk Street, W.C.2.

Extension to Engineering Block, Queen Mary's College, Mile End Road, E.1; Playne & Lacey, architects, 19, Queen Anne's Gate, S.W.1.

Middlesbrough. — Flats (131), Graham Street redevelopment area; J. A. Kenyon, borough engineer.

Nantwich. — Works, Worleston Road; Wilhall Engineering Co., Ltd., Ludford Street, Crewe.

Newcastle (Staffs).—Eleven-storey block of flats, Church Street/Lower Street site, and houses (65), Silverdale; borough engineer, Lancaster Buildings, High Street.

Norfolk.—First instalments of new secondary modern schools at Hellesdon and Sprowston, and three-storey block with four-storey wing at county technical college, King's Lynn; F. L. Ralphs, chief education officer, Stracey Road, Norwich.

Northumberland.—New wing at Kirkley Hall Farm Institute, Ponteland (£35,000); county architect, County Hall, Newcastle-on-Tyne.

Peterlee.—Three-storey flats (48 dwellings) for Peterlee Development Corporation, Old Shotton; W. J. Scott, chief architect.

Plymouth.—Works extensions; Latimer, Trent & Co., Ltd., Crescent Avenue, Mount Pleasant.

Civic Centre; G. A. Jellicoe & Partners, architects. Communications should be addressed to the Plymouth office at 5, Princess Square and not to the London office as shown in our 22nd November issue.

Portsmouth.—Public baths, Anglesea Road; city architect.

Factory and offices; W. G. Lucas & Son, 42/6, Broad Street.

Redcar.—Three branch libraries (£32,000); K. W. Ash, borough engineer.

Rotherham.—Works, Meadowhall Road; Geo. Turton Platts & Co., Ltd., Sheffield.

Rothwell.—Factory for T. Groocock & Co., Ltd., Gordon Street; Gotch, Saunders & Surridge, architects, Bank Chambers, High Street, Kettering.

Rugby.—Dwellings (80), Featherbed Farm and Abbots Farm estates; T. Wilson & Son, Ltd., builders, 65, Sheep Street, Northampton.

Scunthorpe.—Flats (72), Ashby Road/Kingsway corner site; borough engineer, Municipal Offices, 34, High Street.

Sheffield.—Twenty blocks of six-storey maisonnettes, Herdings site, and eighteen blocks on the Hemsworth site, Gleadless Valley estate; city architect, Town Hall.

Southampton.—Millbrook Secondary Girls' School; Howard V. Lobb & Partners, architects, 20, Gower Street, London, W.C.1.

Southgate.—Flats (40), Oakwood area; Roger Malcolm, Ltd., builders, Malcolm House, Empire Way, Wembley.

Synagogue, Old Farm Road; Julian Keyes, architect, 13, Wimpole Street, London, W.1.

Spennymoor.—Houses (156), Middlestone Moor and Kirk Merrington, for U.D.C.; Gray & Partner, architects, Camden Street, North Shields.

Stockport. — Fire station at Reddish (£80,000); J. Rank, borough architect.

Sutton Coldfield.—Houses (240), School Farm estate; Carlton Contractors, Ltd., Ashley Road, Epsom.

Worthing.—Works, Clarendon Road; C. L. Bencard, Ltd., Minerva Road, London, N.W.10.

Burma's Electrical Imports

Although last year Burma's electrical imports (£2·5 million) were about the same in aggregate value as in 1955 (£2·4 million) the United Kingdom's share decreased from £1·8 to £1·2 million.

The *U.K. Trade and Navigation Accounts* show that among the more important imports from the United Kingdom which decreased considerably were generators and motors (from £484,474 in 1955 to £224,683 in 1956), switchgear (£264,802 to £256,468), electronic valves and sound reproducing equipment (£304,555 to £187,195), and cables and wires (£276,415 to £134,399).

The principal foreign competitors were West Germany (£414,000), Sweden (£240,000), China (£212,000), the United States (£117,000) and Japan (£98,000). Extensive barter agreements with the Eastern European countries enabled them also to get an increasing share of the Burmese market.

BURMESE IMPORTS OF ELECTRICAL GOODS, 1956. (1 kyat = 1s 6d)

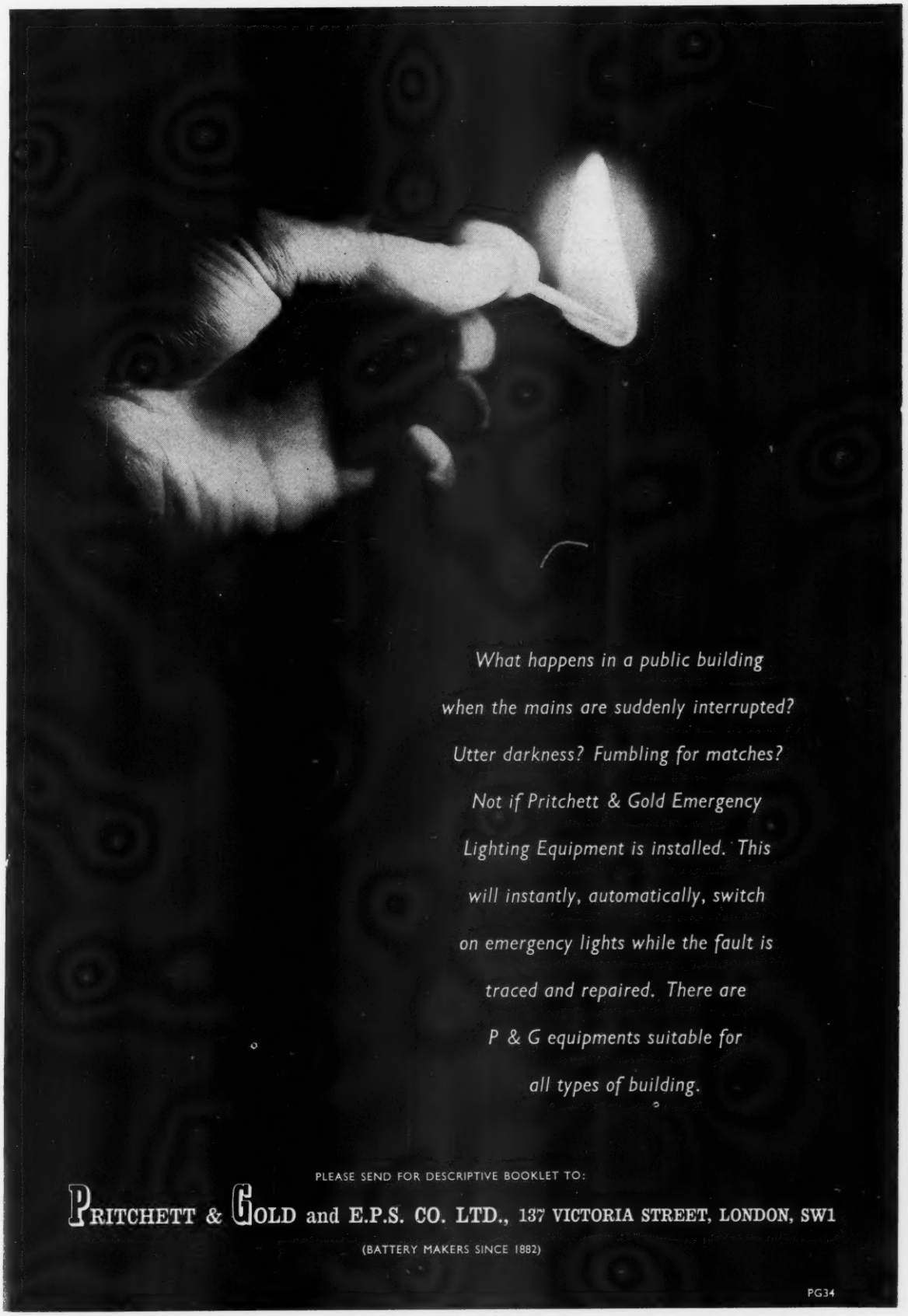
Product	Value (000 kyat)
Generating equipment	13,101
From United Kingdom	9,662
,, United States	297
,, West Germany	2,700
,, Czechoslovakia	101
Control apparatus	1,170
From United Kingdom	29
,, West Germany	1,039
,, East Germany	100
Electric lifts and parts	119
From United Kingdom	69
Electrical machinery, n.e.s.	504
From United Kingdom	65
,, West Germany	367
Parts of electrical machinery, n.e.s.	1,049
From United Kingdom	814
,, West Germany	140
,, Japan	34
Refrigerating equipment	1,103
From United Kingdom	189
,, United States	375
,, Israel	192
,, Singapore	228
Portable tools	737
From United Kingdom	176
,, China	154
,, Japan	332
Electro-medical appliances	373
From United Kingdom	190
,, Belgium	107
Radio receivers	148
From United Kingdom	32
,, Holland	58
,, West Germany	36
Radio apparatus, n.e.s.	1,065
From United Kingdom	943
,, United States	106
Telegraph apparatus	1,882
From United Kingdom	127
,, Sweden	835
,, United States	866
Measuring instruments	784
From United Kingdom	100
,, West Germany	609
,, Czechoslovakia	40
,, East Germany	30
Cable, insulated	5,450
From United Kingdom	1,191
,, Canada	865
,, Sweden	2,370
,, Russia	439
,, Israel	233
,, Japan	139
Batteries	2,901
From China	2,230
Accumulators	1,673
From United Kingdom	1,183
,, West Germany	262
Light fixtures	2,104
From United Kingdom	1,494
Electric lamps	1,027
From United Kingdom	144
,, Czechoslovakia	137
,, East Germany	181
,, China	191
,, Japan	211

Thailand's Imports

During 1956 the United Kingdom's share in Thailand's electrical imports decreased to £1·1 million (from £1·6 million in 1955), but the United Kingdom remained Thailand's principal supplier. Other large suppliers of electrical goods were the United States, the Netherlands and West Germany.

Following a visit by one of their representatives, the International Bank for Reconstruction and Development have in principle approved the grant of a loan for the important Yan Hee hydro-electric project. The first phase of this project, including the distribution network, will cost approximately £46 million. The later stages, including the installation of power units up to a total of eight, with an output of 560 MW, will account for another £29 million. In order to provide for an increased electricity consumption until the inauguration of the Yan Hee plant, the United States I.C.A. aid authorities are considering an interim assistance by financing a 10 MW thermal plant at Mae Moh and a 10 MW diesel plant for Bangkok. (£1=57 baht.)

Product	1956 baht (000)
Generating sets, complete	21,341
From United Kingdom	10,761
,, Denmark	2,921
Motors	10,846
From United Kingdom	4,751
,, West Germany	2,596
Electric cells and batteries, dry	31,239
From United Kingdom	1,752
,, Singapore	3,658
,, United States	15,806
Radio receivers, without record player	57,171
From United Kingdom	3,068
,, West Germany	19,697
,, Holland	25,669
Telephone apparatus	15,211
From United Kingdom	7,811
,, West Germany	1 761
,, Sweden	1,596
Cables and wires	55,353
From United Kingdom	4,919
,, Japan	17,429
,, Denmark	1,236
,, West Germany	14,872
,, United States	13,044
Accumulators	13,100
From United Kingdom	5,779
,, West Germany	2,553
,, Holland	1,073
,, United States	2,216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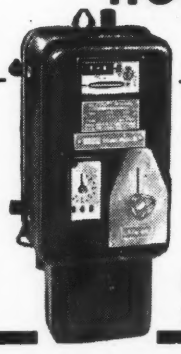

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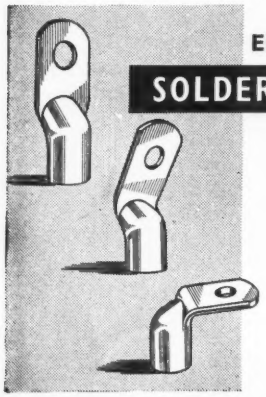

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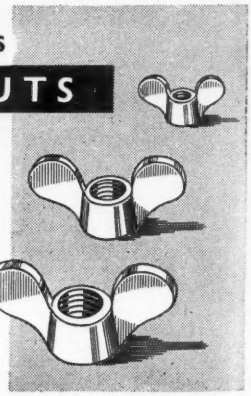

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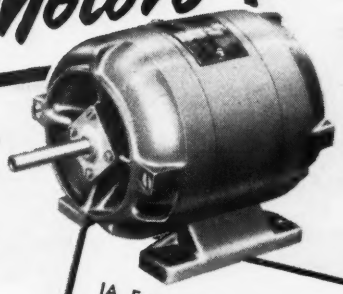

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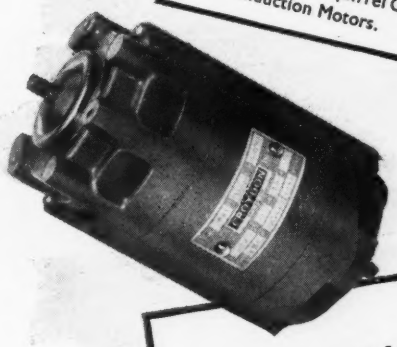

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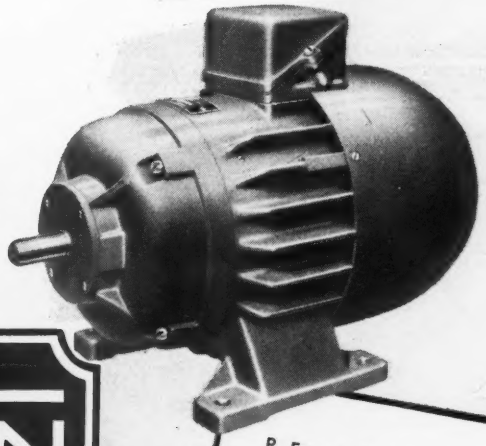

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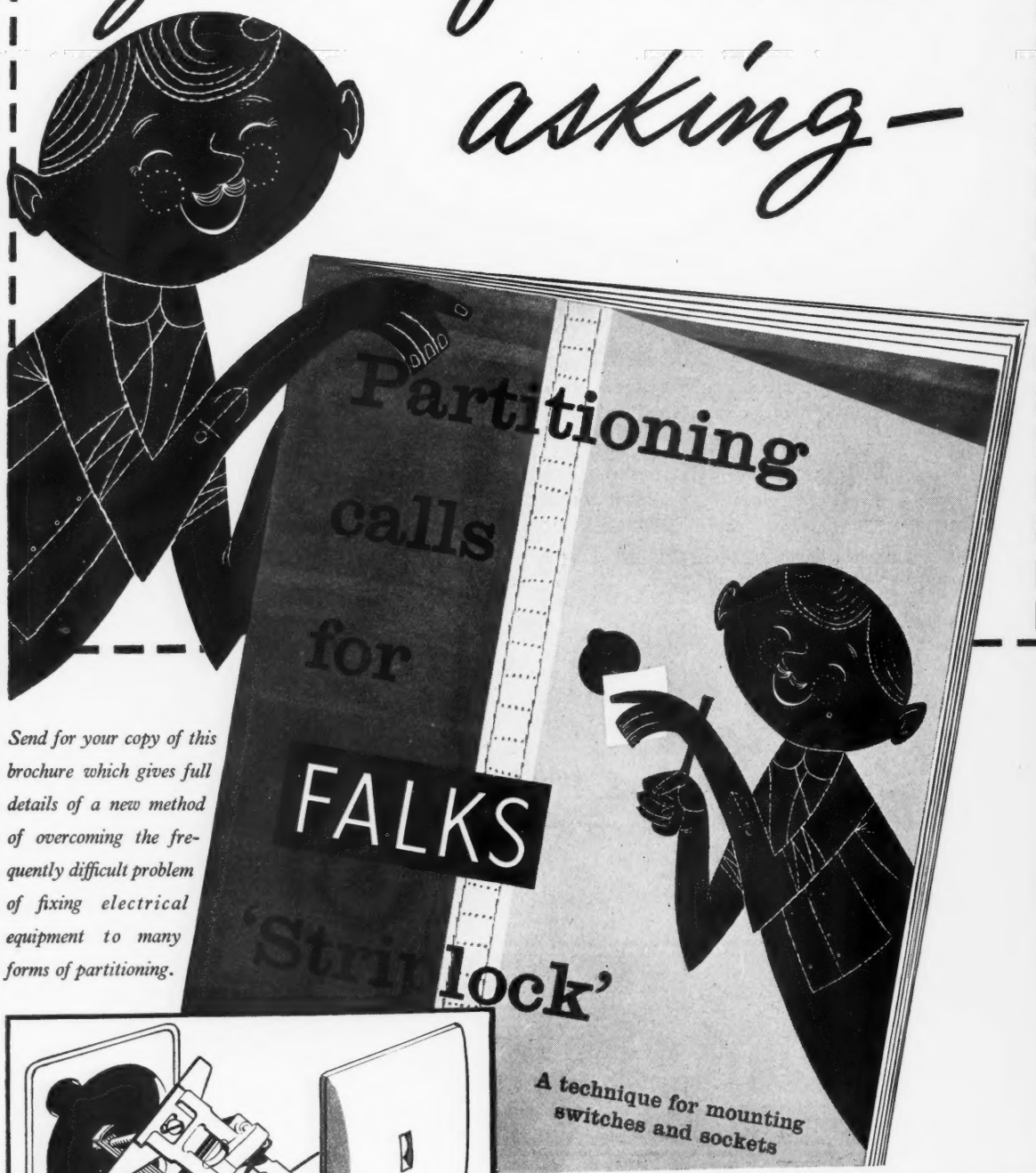

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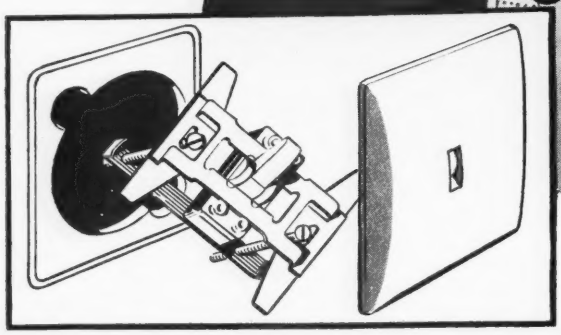

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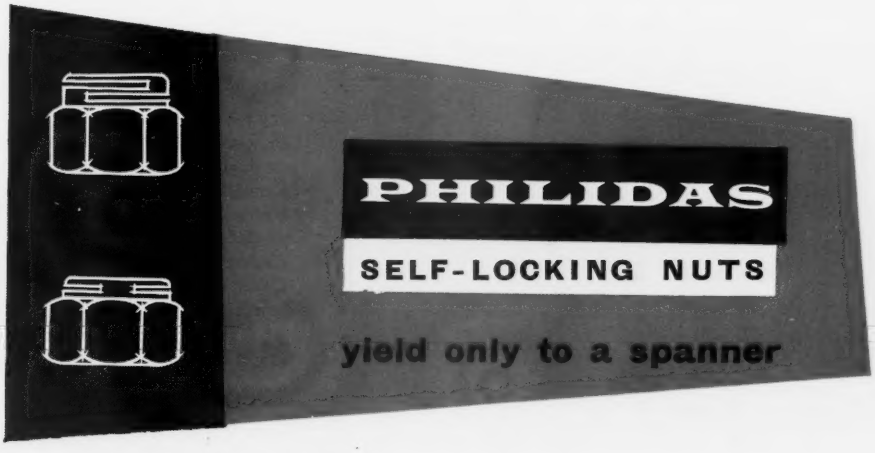

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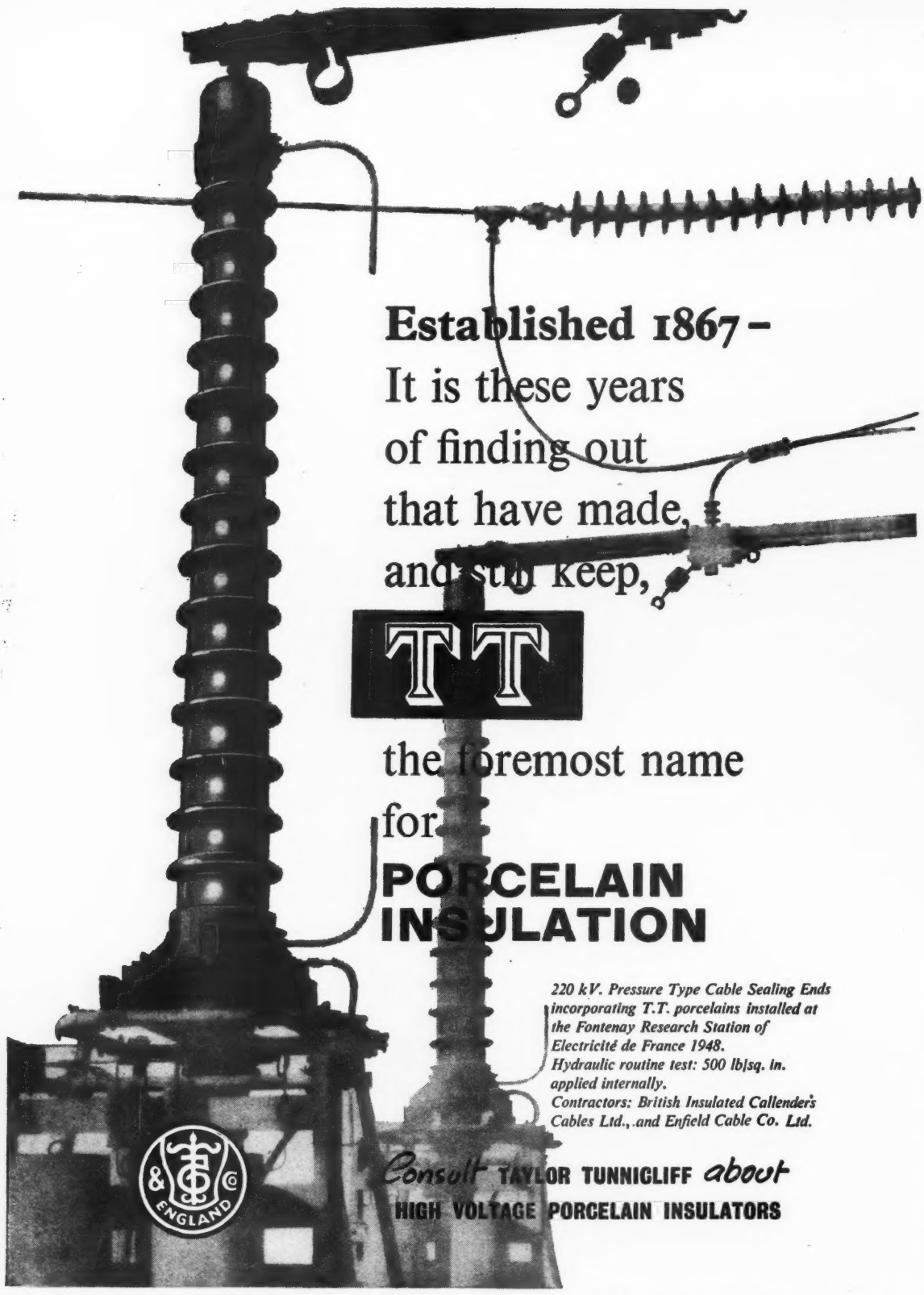

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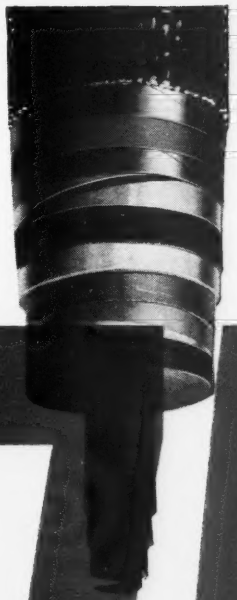

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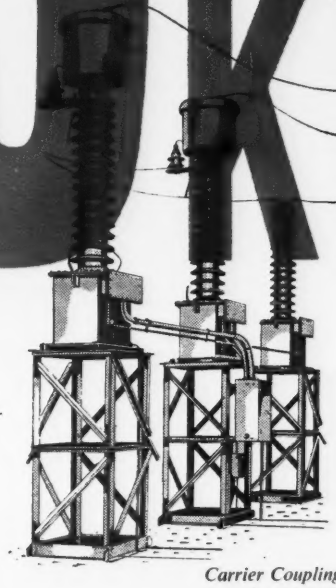

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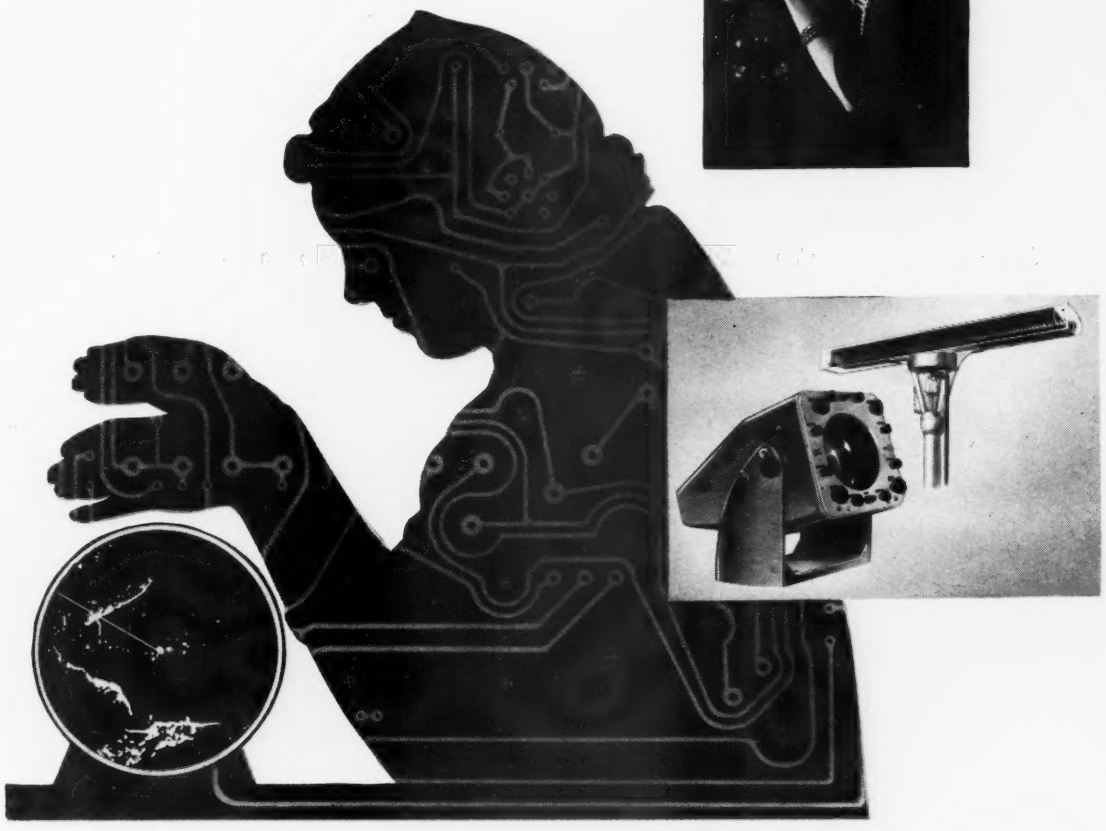

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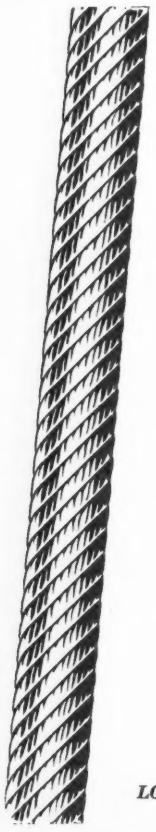

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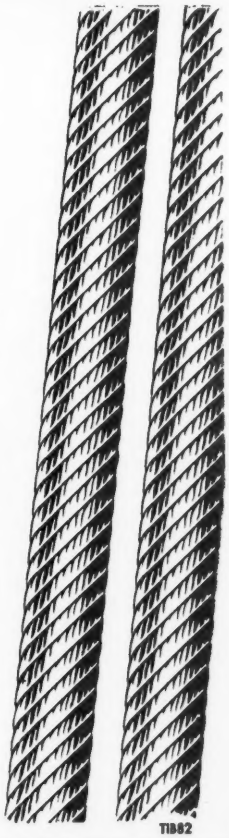

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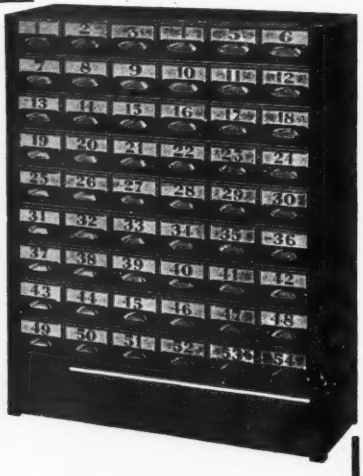

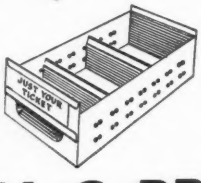

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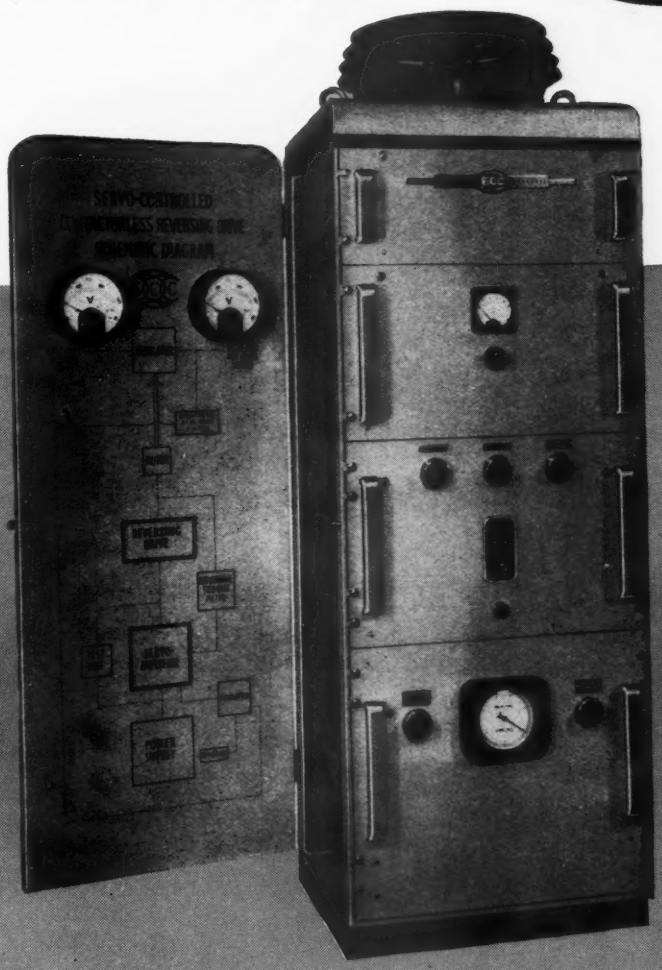

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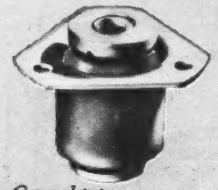
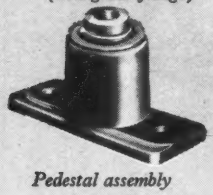
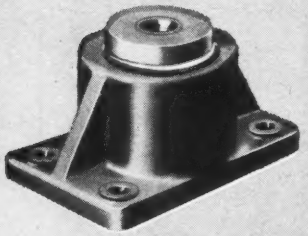


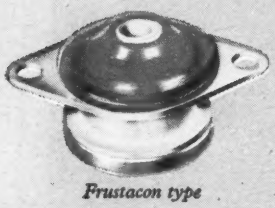
General type (triangular flange)



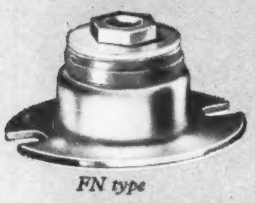
Pedestal assembly



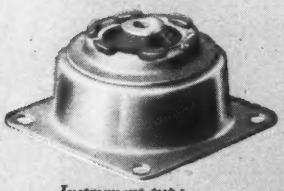
Pedestal mounting



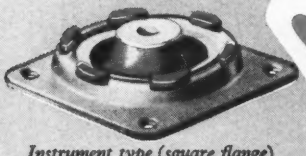
Frustacon type



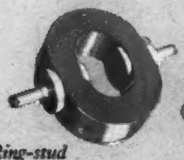
FN type



Instrument type (pedestal flange)



Instrument type (square flange)



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IVER, BUCKS.

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Telegrams: Britannic, Iver

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by STRONG

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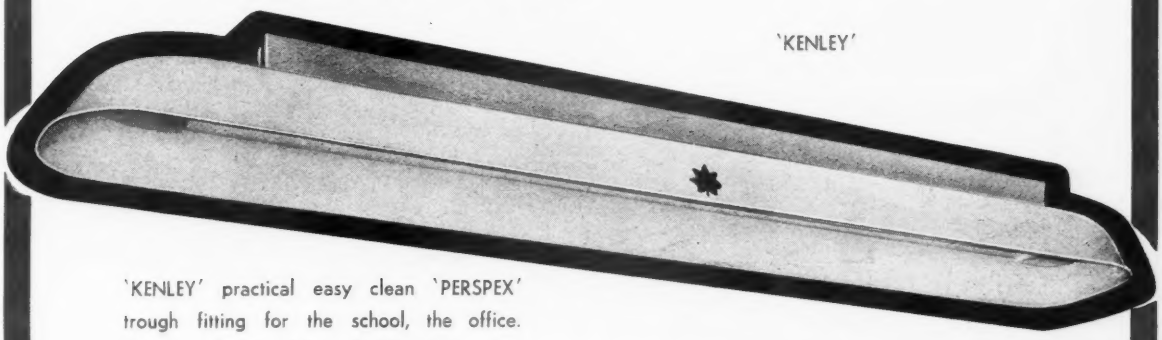

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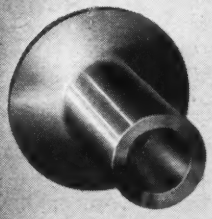

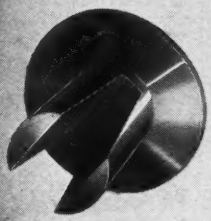

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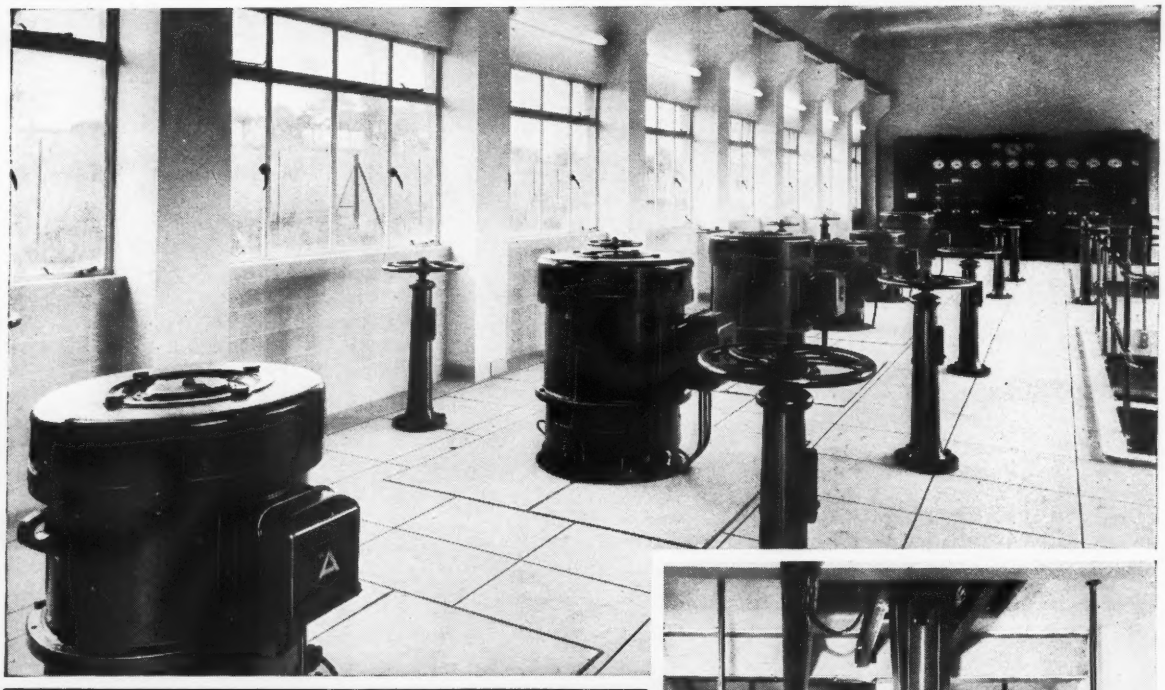

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Clause 16:	Temperature Rise at current rating.
Clause 17:	Time Current Characteristics.
Clause 18:	Minimum Fusing Current.
Clauses 19–22:	Short Circuit Performance.

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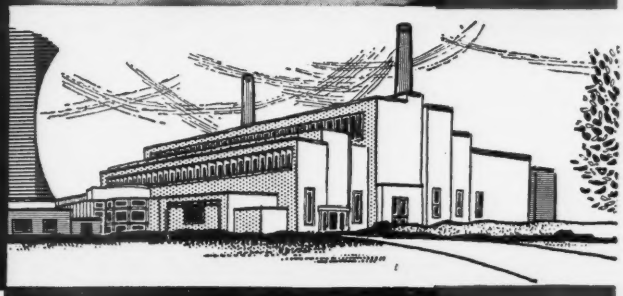

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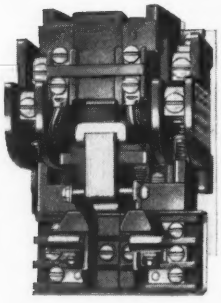
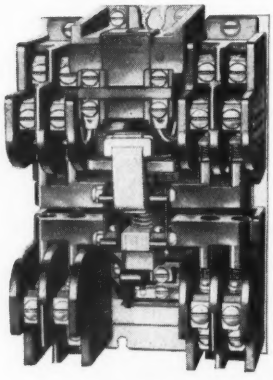


● **2-pole Open Style Relay with two changeover coil circuit contacts.**



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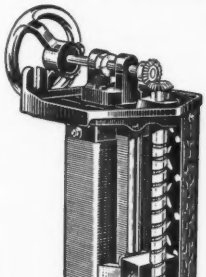

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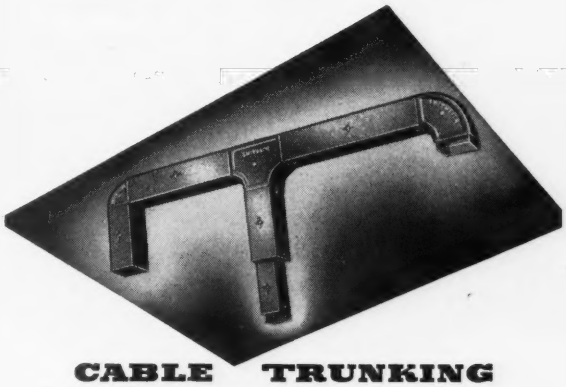

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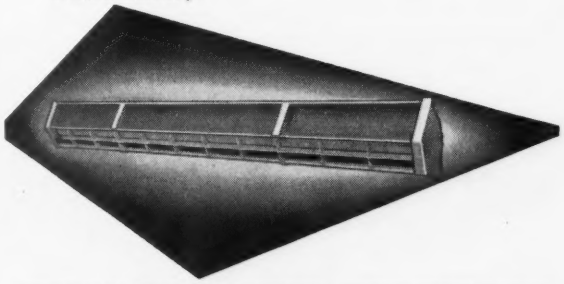

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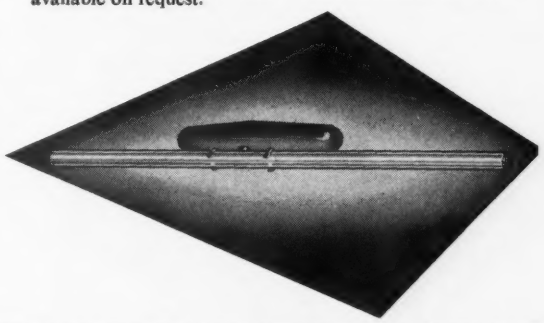

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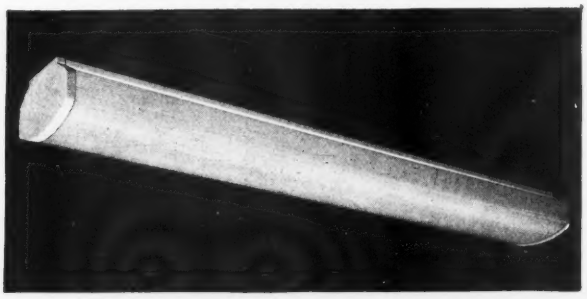

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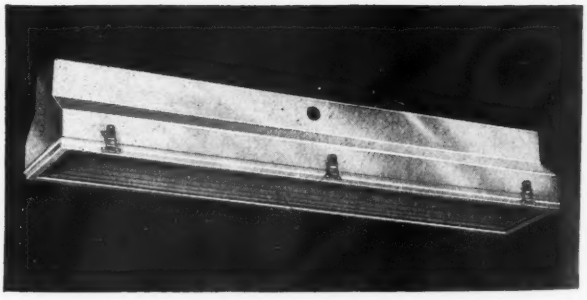

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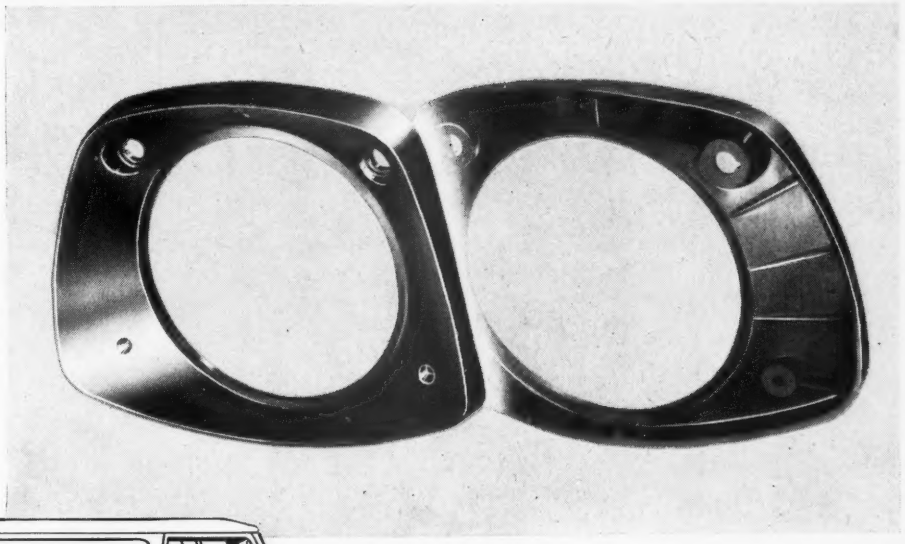

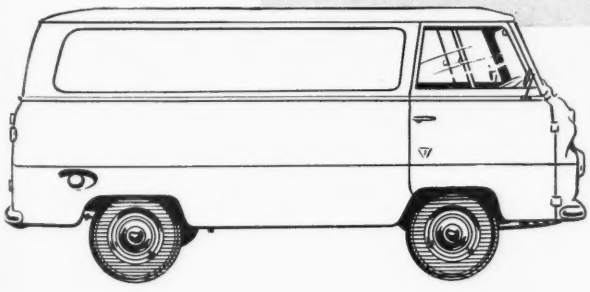

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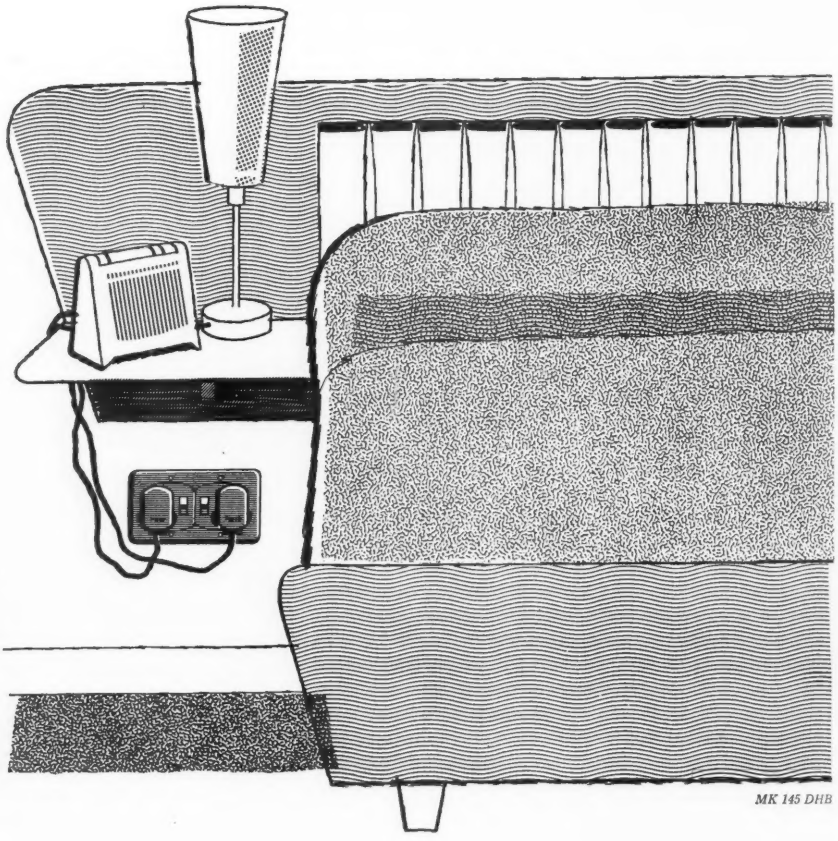
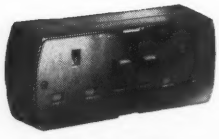
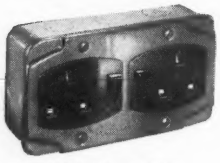


MK 145 DHB



List No. 2949



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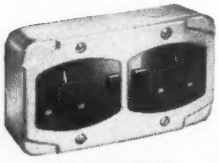

List No. 2946

List No. 2947

List No. 2948

TWIN SWITCHSOCKET-OUTLETS ARE THE ANSWER

In the planning of an electrical installation, there are certain 'natural' sites for socket-outlets. At the bedside, over the kitchen work top and on both sides of the fireplace are just three instances.

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for service up to 5000 amps
at 660 volts

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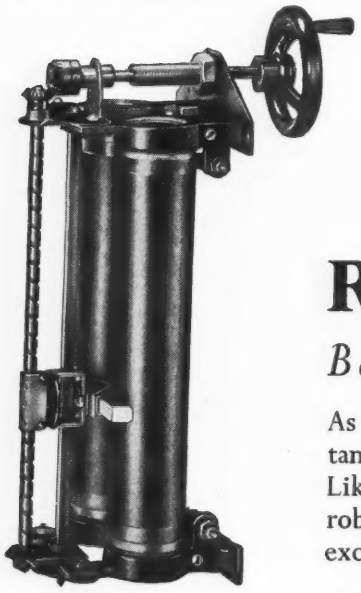

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TUBULAR SLIDING RESISTANCES

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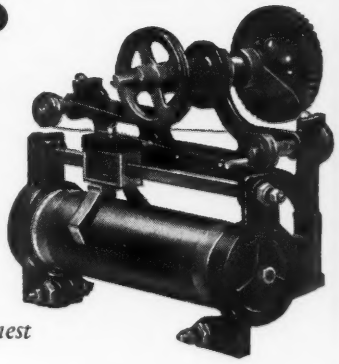

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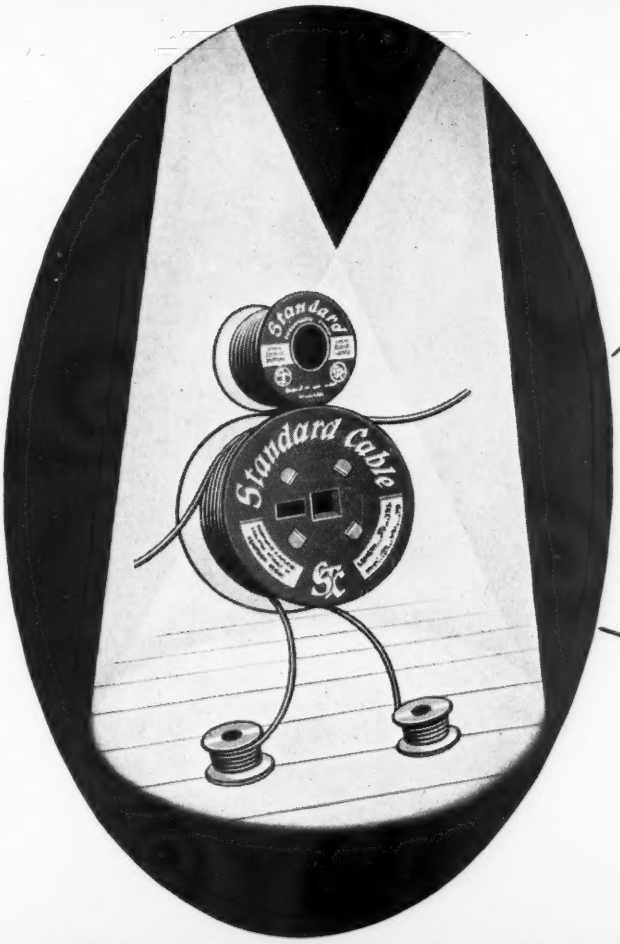

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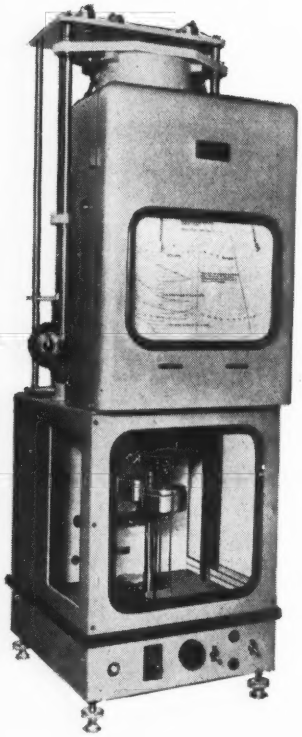

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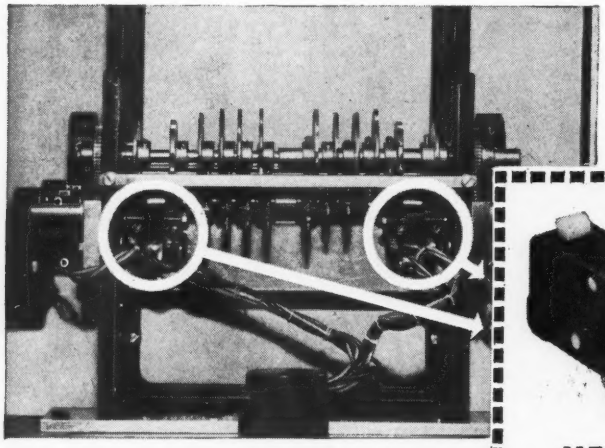
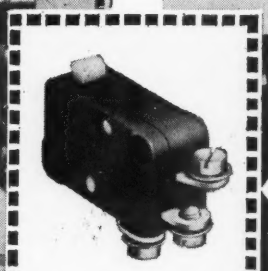
MICRO SWITCHES

limit movements and initiate sequences in industrial and laboratory test equipment— in the Stanton Thermobalance for example.

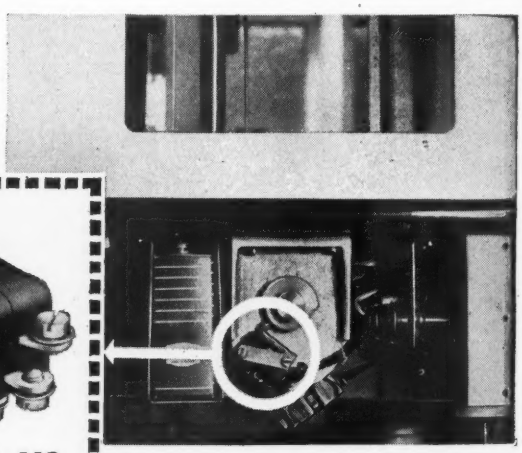
The Stanton Thermobalance, manufactured by Stanton Instruments Limited, 119 Oxford Street, London W.1, finds worldwide use in industrial and research laboratories for the accurate measurement of weight changes under conditions of varying temperature.



Mechanism of the patented Electric Weight Loading Device, showing four Burgess V3 Micro Switchettes fitted with VLR1 Auxiliary Actuators arranged for cam actuation.



The **NEW V3** Micro Switchette with Nylon Plunger.



Operation of a Burgess V3 Micro Switchette fitted with VLR1 Auxiliary Actuator in the Automatic Periodic Timer.

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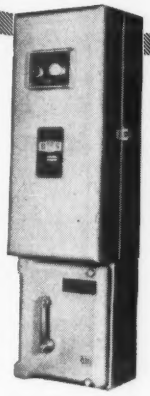
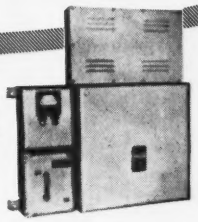
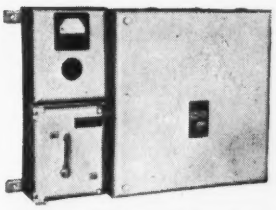


(Left)
Heavy Duty Direct On-Line Starters. Suitable for controlling motors up to 30 h.p.
List DO 60.



Automatic Stator Rotor Starters. Suitable for controlling slip ring motors up to 40 h.p.
List SR 60.



Heavy Duty Automatic Star Delta Starters. Suitable for controlling motors up to 55 h.p.
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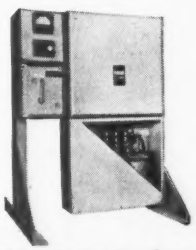

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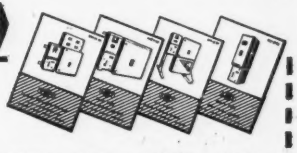

To: BRITISH KLOCKNER SWITCHGEAR LTD. CHERTSEY, SURREY

Please send me copy of List **AT 60** **SR 60** **DO 60** **SD 60**
INDICATE BY TICK WHICH LIST/S REQUIRED

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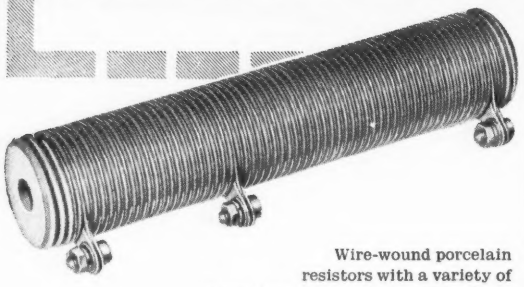
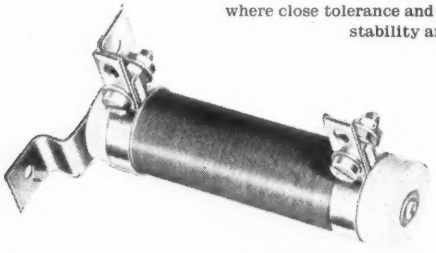
POSITION .....
FIRM AND .....
ADDRESS .....
.....

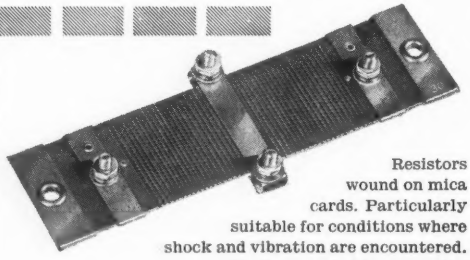
E.R.

WIRE WOUND RESISTORS



Wire-wound porcelain resistors with a variety of mountings. Mainly for small loadings where close tolerance and electrical stability are needed.





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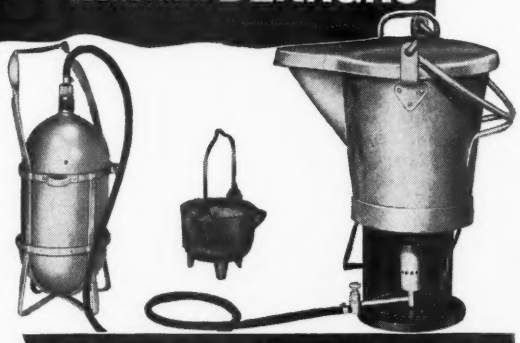

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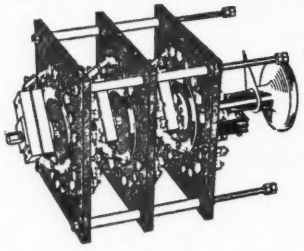

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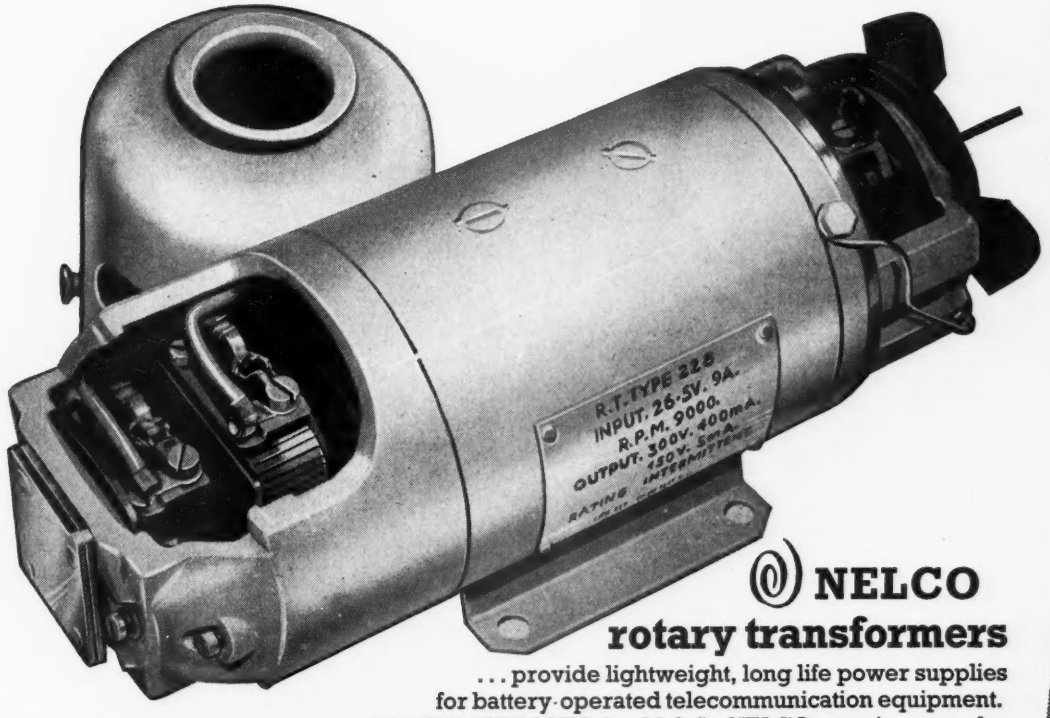

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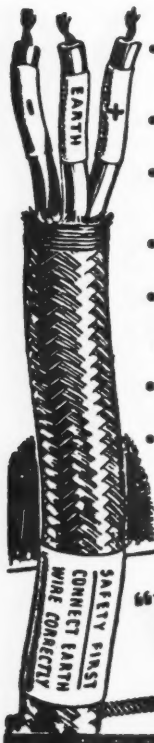

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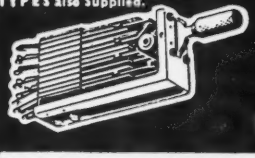

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throwing light on the subject —of easy to maintain lighting equipment

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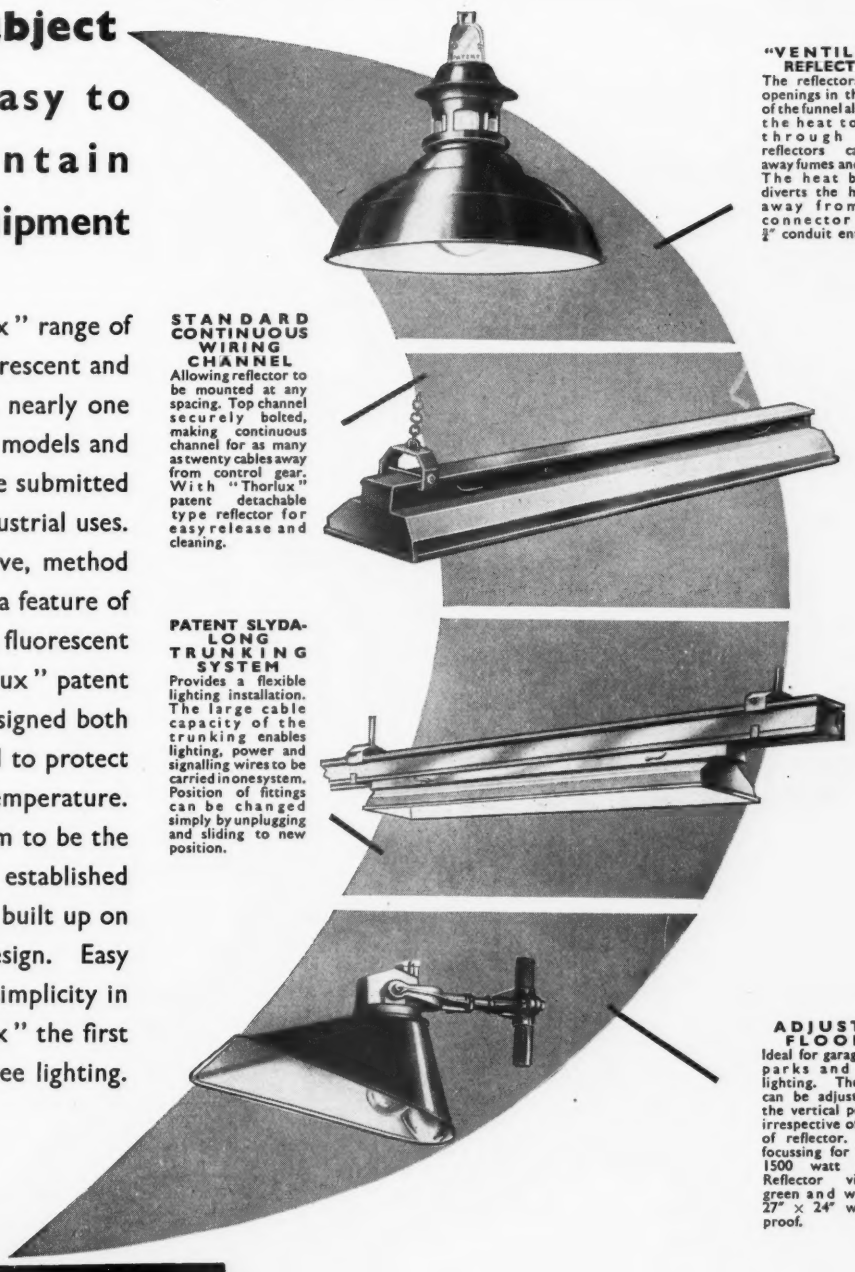

"VENTILUX" REFLECTOR
The reflectors have openings in the side of the funnel allowing the heat to rise through the reflectors carrying away fumes and dust. The heat baffle diverts the hot air away from the connector box. ¾" conduit entry.

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Allowing reflector to be mounted at any spacing. Top channel securely bolted, making continuous channel for as many as twenty cables away from control gear. With "Thorlux" patent detachable type reflector for easy release and cleaning.

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Provides a flexible lighting installation. The large cable capacity of the trunking enables lighting, power and signalling wires to be carried in one system. Position of fittings can be changed simply by unplugging and sliding to new position.

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Ideal for garages, car parks and flood-lighting. The lamp can be adjusted to the vertical position irrespective of angle of reflector. With focussing for 300 to 1500 watt lamps. Reflector vitreous green and white, 27" × 24" weather proof.

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IMPORTANT *We are proud of our share in developing the "Overlamp" type of reflector. Our patented detachable trough is also rapidly becoming as popular in industry. Comprehensive Catalogue ER 1057 covering complete range sent on request.*

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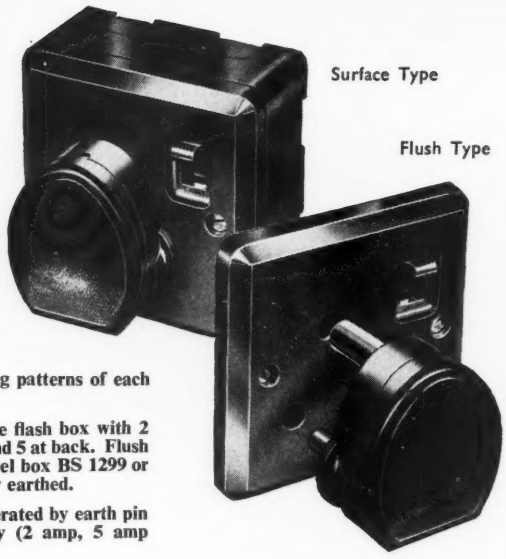
SHUTTERED SWITCHED SOCKET-OUTLETS

2 amp, 5 amp or 15 amp units of same dimensions



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Flush Type

This latest design of Contactum A.C. Shuttered Switched Socket-Outlets is a multi-purpose unit. It provides easily installable and completely safe light, heat or power points. Attractive in design and colour, it is popular for new or additional installations, and is competitively priced.

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- ★ **Surface type has Bakelite flash box with 2 knockouts on each side and 5 at back. Flush type fits into standard steel box BS 1299 or 1363 and is automatically earthed.**
- ★ **Unique shutter device operated by earth pin and plug, ensuring safety (2 amp, 5 amp and 15 amp).**
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- ★ **Finger shield 3-pin plugs of strong, neat construction.**
- ★ **Units with matching plugs available in Brown or White Bakelite.**

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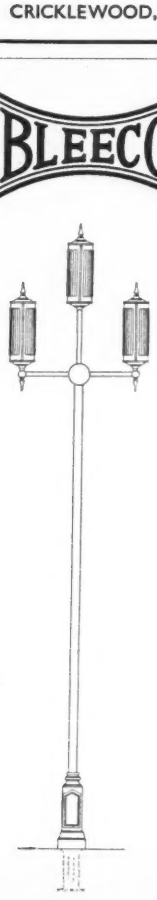
FLUORESCENT FITTINGS *for* **STREET LIGHTING**



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Ornamental Unit for Group A Lighting in Town Centres and Similar Situations.

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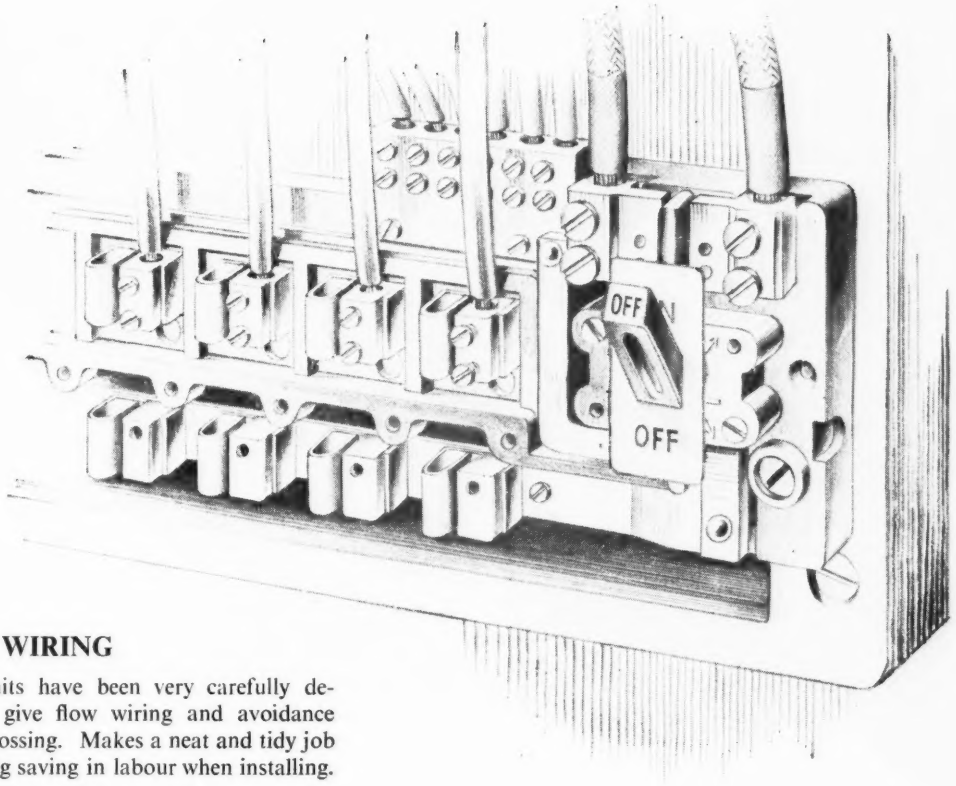

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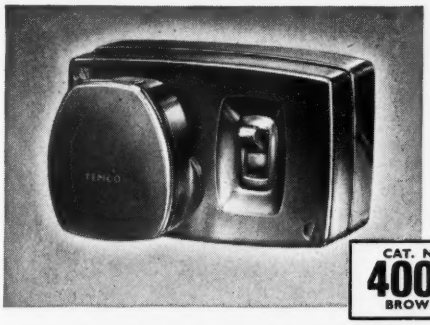

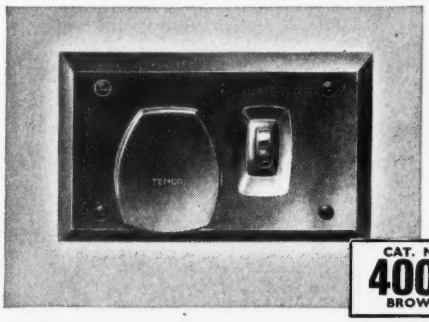

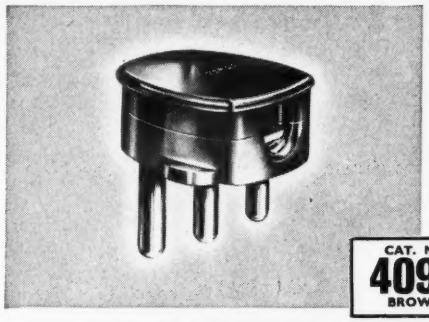

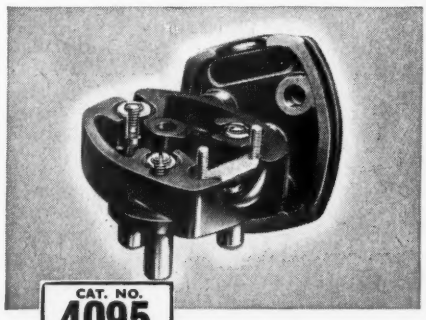

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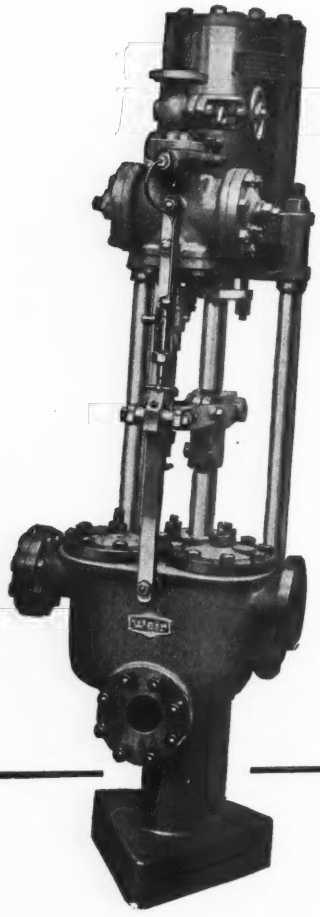

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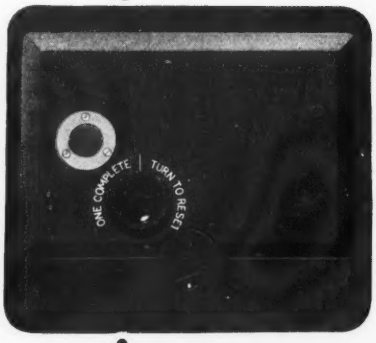

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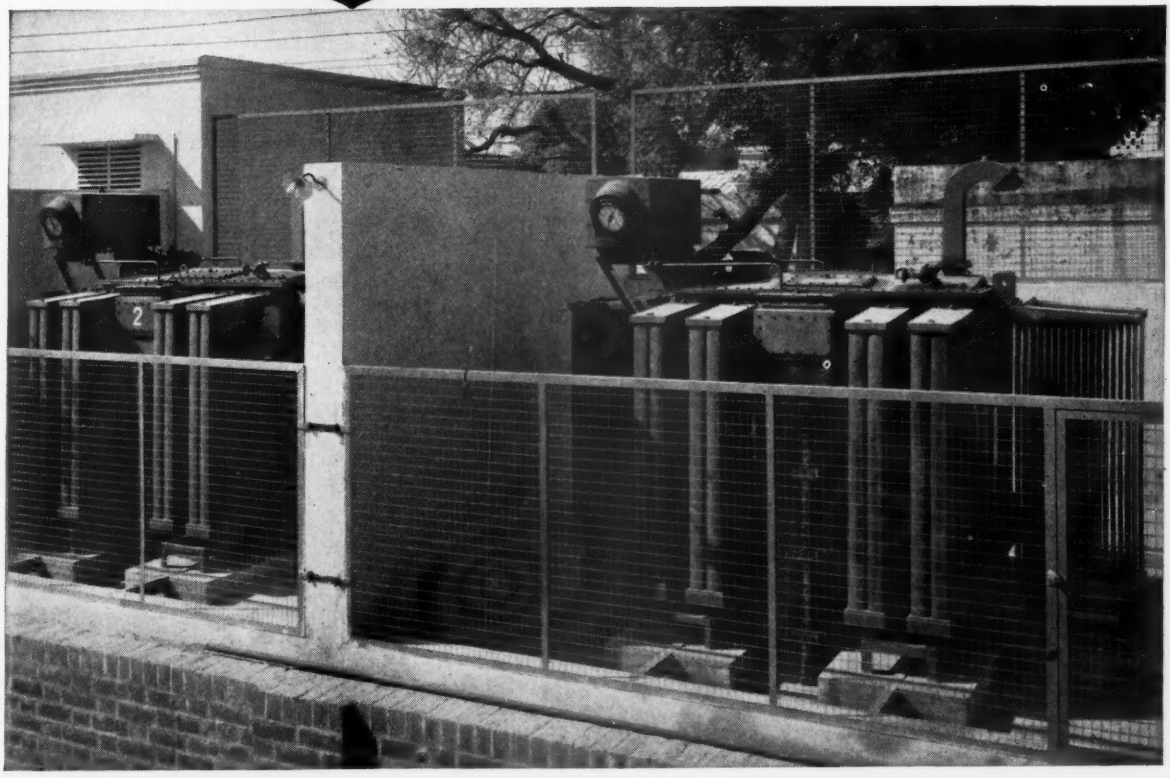

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SC181

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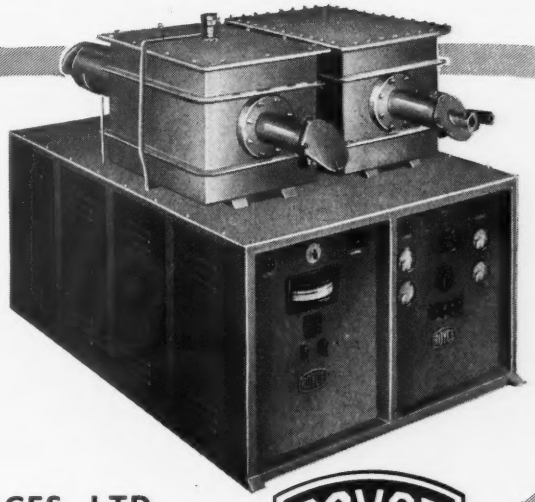

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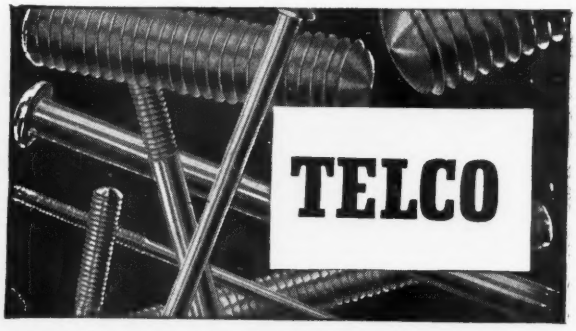

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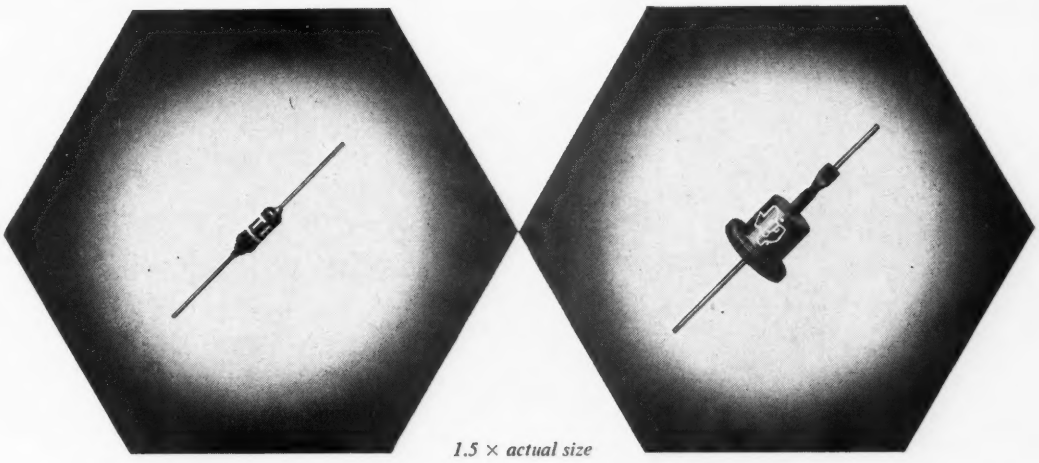

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		'MOLY G'		'METAL CASE'			
MAXIMUM RATINGS	Average rectified Forward Current at 25°C	400		750		mA	
	Average rectified Forward Current at 150°C	150		250		mA	
	Recurrent Peak Forward Current at 25°C	1.25		2.5		Amp.	
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SPECIFICATIONS	Max. Reverse Current at P.I.V. 25°C	0.2		10.0		μA	
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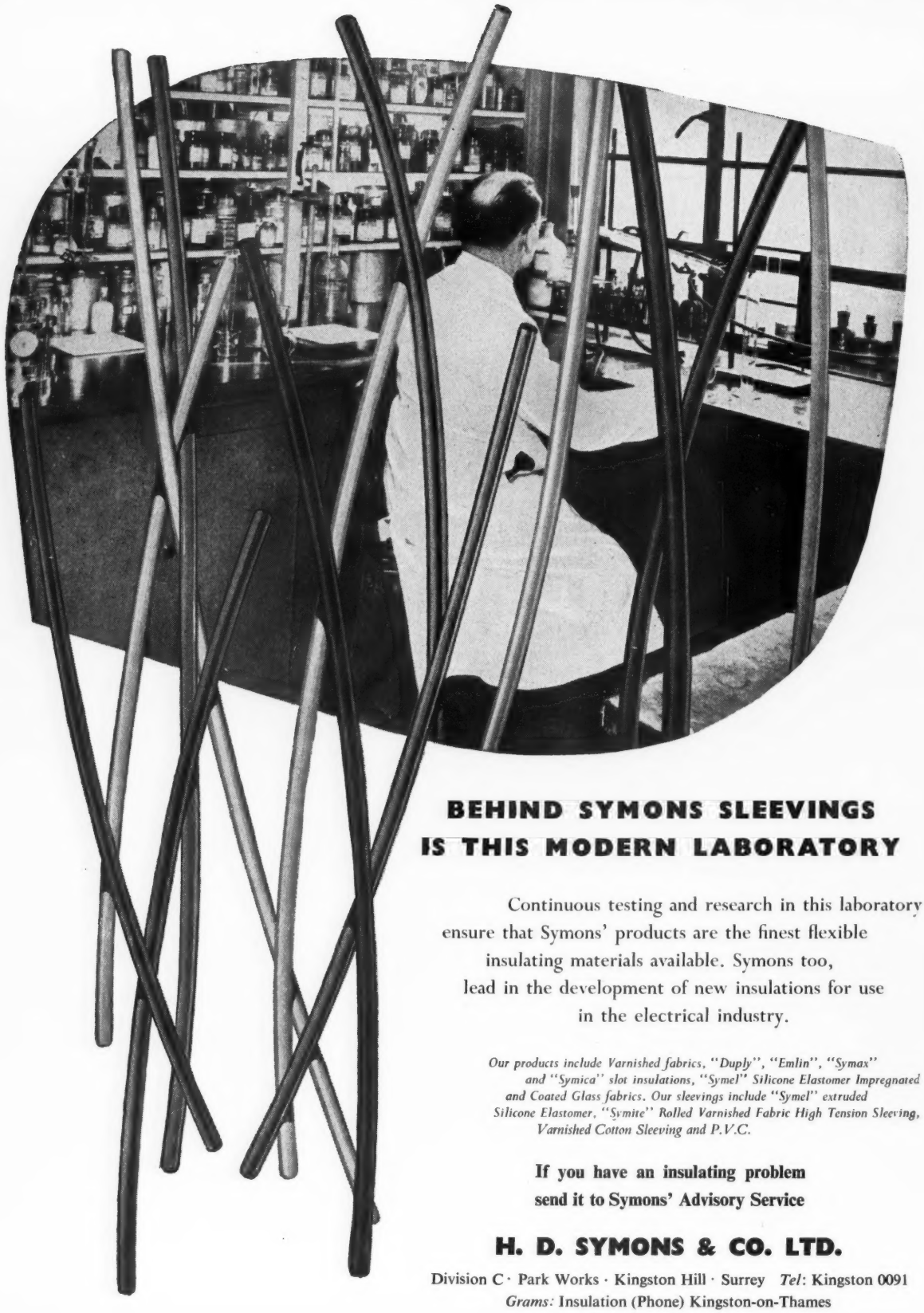

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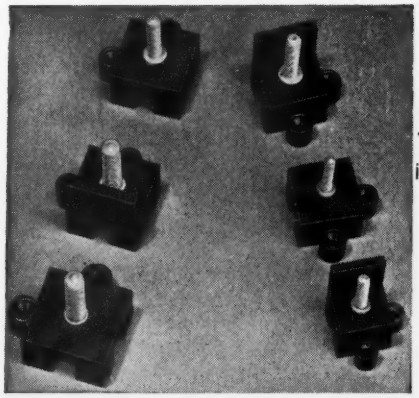

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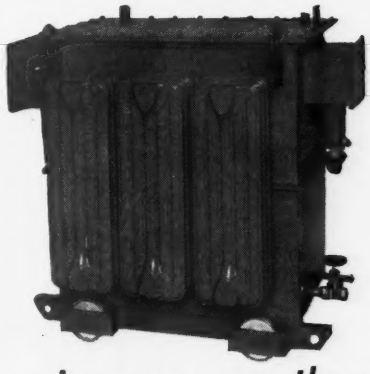

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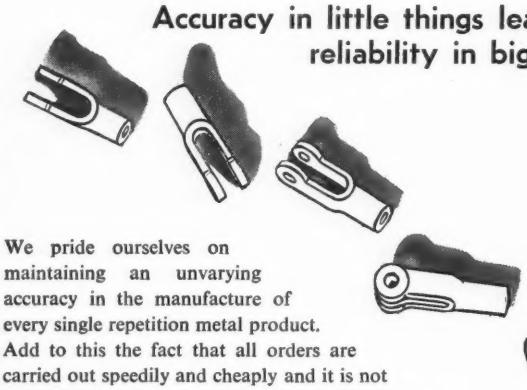

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C52/A

UNIT AND CUBICLE CONSTRUCTION SWITCHBOARDS

Illustration on right shows an indoor totally enclosed unit construction type "Y" switchboard with incoming duplicate busbars feeding common outgoing circuits by means of interlocked fused switches of both 300 amp and 500 amp capacity.

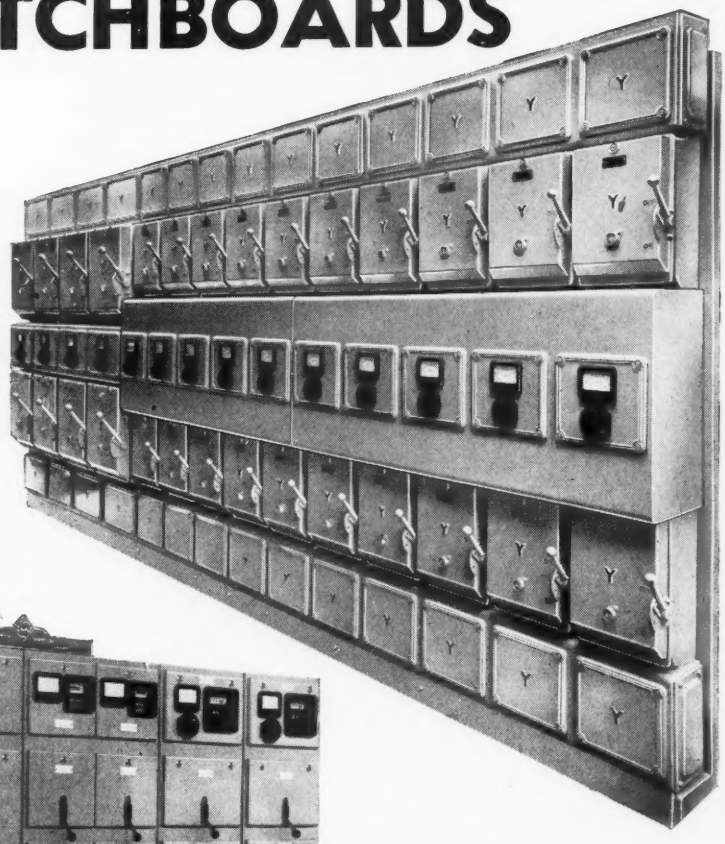
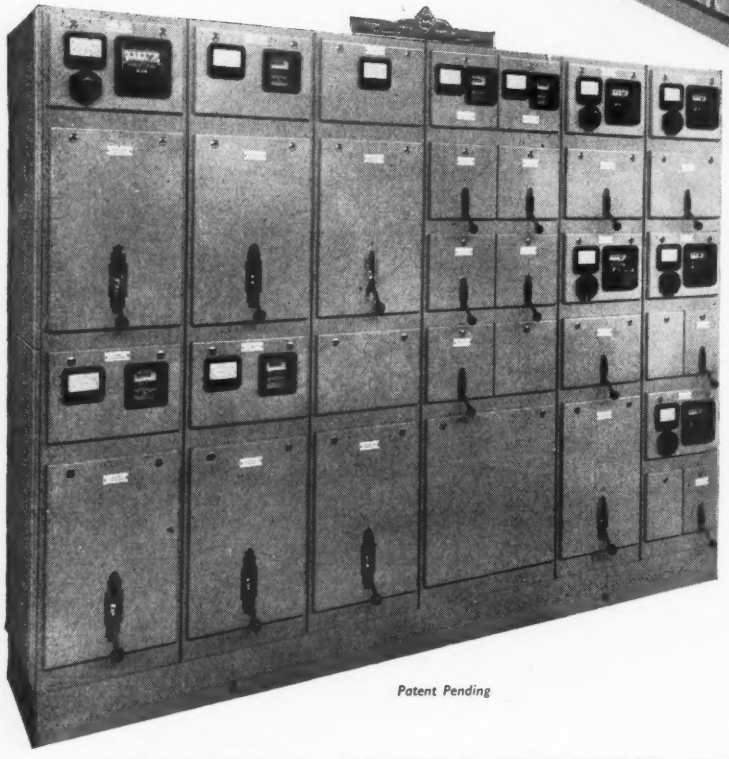


Illustration below shows an indoor all-isolating cubicle construction switchboard having individual metering on the outgoing fused switches of 60 amp, 160 amp and 300 amp capacity.



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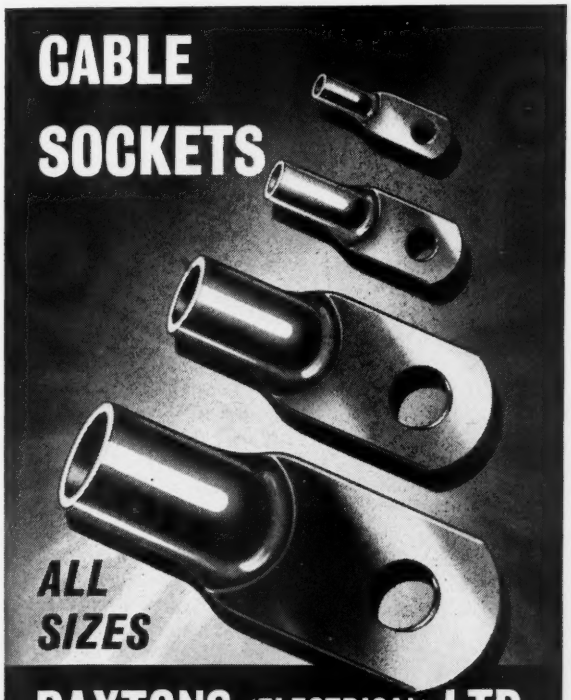

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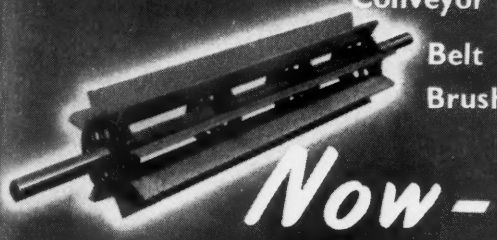

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THE Kleen-e-ze BRUSH CO. LTD.
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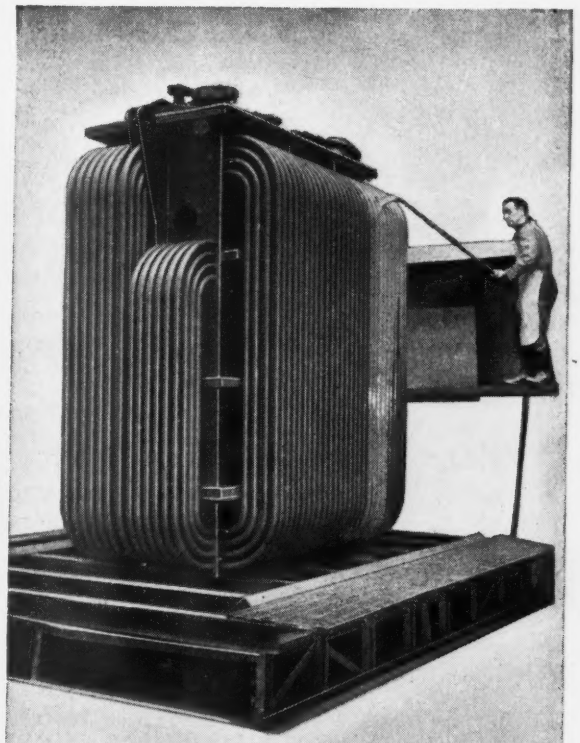


STERLING PAINTS FOR FLOOD PAINTING TRANSFORMERS

Photo by courtesy of Messrs. Ferranti Ltd.

Use STERLING PAINTS for floodpainting transformer tanks, and you can —

- ***Cut labour costs by 50%!***
- ***Cut paint consumption by 25%!***
- ***Get protection where it is needed!***

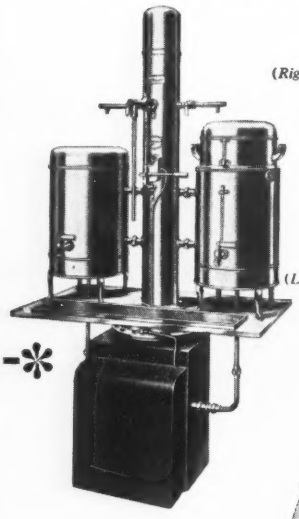
Requests for further information will be welcomed.

MADE BY CHEMISTS
SPECIAL Sterling INSULATING VARNISHES PAINTS
SERVICED BY ENGINEERS

THE STERLING VARNISH CO. LTD.
Fraser Road, Trafford Park, Manchester 17
Telephone: Trafford Park 0282 (4 lines) Telegrams: 'DIELECTRIC MANCHESTER'
London Office & Warehouse: 6 London Road, Brentford, Middlesex
Telephone: EALING 9152

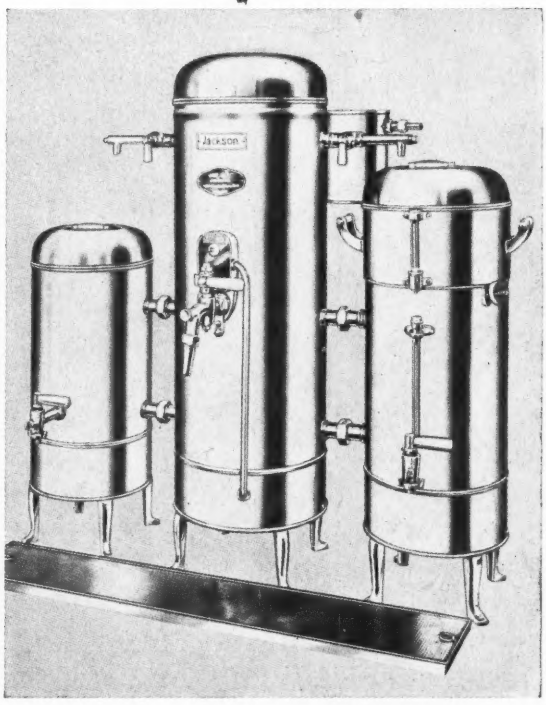
dm. ST.7

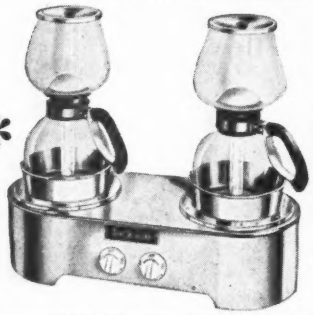
'Jackson' Boilers are best in every situation and for all catering needs

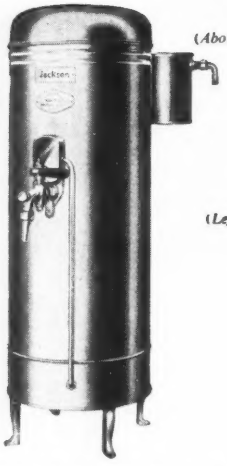


(Right) **SELF-CONTAINED STILLROOM SET**
This 'Jackson' Boiler is fitted with Pyrex or Stainless Steel lined milk and coffee urns incorporating the Filtomaton system of coffee making. Additional urns of 6, 12, 16, 24 or 32 pint capacity can be fitted if desired.

(Left) **CAFE FOUNTAIN SET**
An under counter boiler which can be supplied as a separate unit or fitted with one or more Pyrex or Stainless Steel lined milk or coffee urns incorporating the Filtomaton system of coffee making. Its pleasing appearance makes it especially effective for counter service.







(Above) **TWO FLASK GLASS COFFEE MAKER**
Intended to meet the requirements of those Caterers with a limited demand. The 'Jackson' Coffee Maker has been designed to give greater speed and safety in operation and incorporates a system of coffee making which ensures consistently good coffee.

(Left) **SINGLE BOILER**
Self-feeding and complete in itself. Can maintain a continuous flow of positively boiling water.
Popular Model: an efficient and well made boiler—smaller than the standard model—where a limited boiling water service is required.

The fine materials and workmanship that go into 'Jackson' Boilers mean improved all-round performance, fewer maintenance worries, smoother service and better tea and coffee. There is a 'Jackson' boiler for every catering requirement and for all methods of heating.

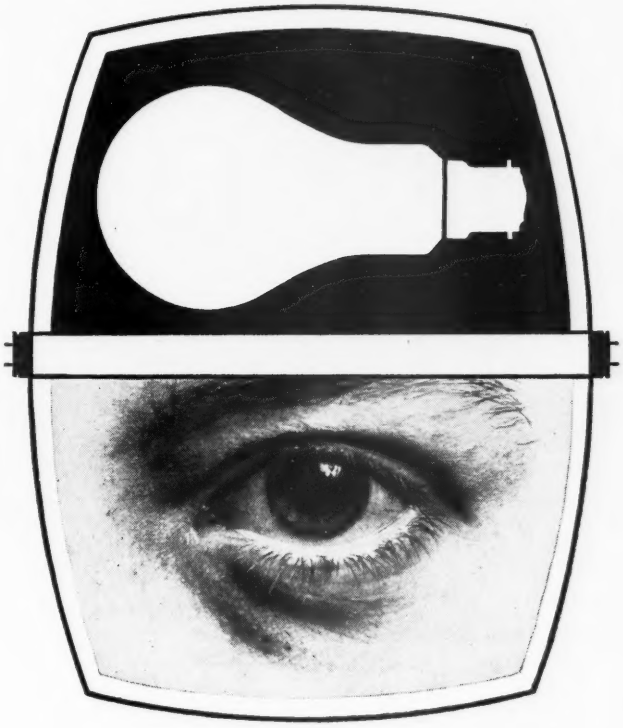
Jackson Boilers Ltd. Vulcan Works, Shafton Lane, Leeds 11. Tel: 3-1088

Jackson Boilers

Showrooms: 25 Victoria Street (entrance in Abbey Orchard St.), Westminster, S.W.1, 202 Corporation Street, Birmingham; 219 West George Street, Glasgow; 1 North Parade, Parsonage Gardens, Manchester; 9 King Street, Leeds.

BY APPOINTMENT
TO HER MAJESTY THE QUEEN
MANUFACTURERS OF ELECTRIC LAMPS

don't say 'lamps'–
say Crompton

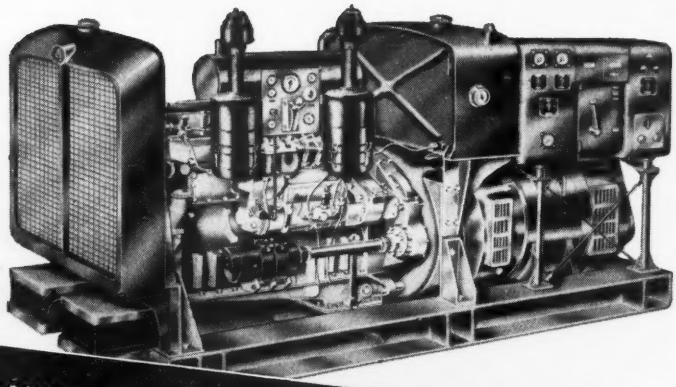


–you'll *see* why!

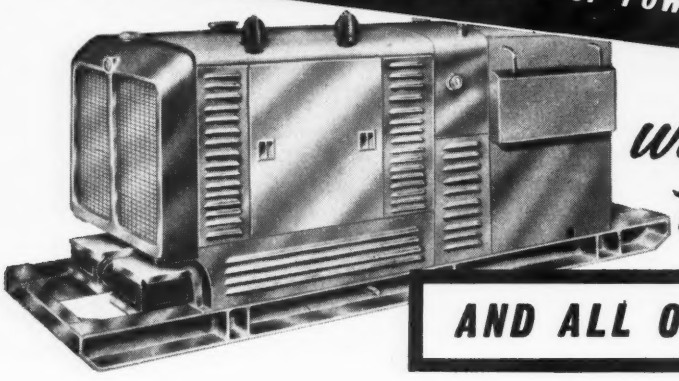
CROMPTON PARKINSON LTD., CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2. TEL: CHANCERY 3333. 'GRAMS: CROMPARK ESTRAND LONDON

MEADOWS

now introduce



THE MOST COMPREHENSIVE RANGE OF POWER UNITS AVAILABLE TODAY



with 5000 variants to choose from...

AND ALL OF THEM STANDARD!

Based on the six well proven Meadows diesel engines, a new range of Power units is now available, providing generating sets from 22-161 kW and power packs from 35-235 S.H.P.

Maximum interchangeability of components and world wide spares and service facilities through a network of agents ensure a long life of trouble-free operation.

DOMINANT FEATURES:

Low prices and higher outputs give reduced cost per k.W.

Adaptability to virtually any specification by selection from a wide range of variants.

Extended power range and consolidated range of outputs.

Unit construction for maximum economy in assembly and interchangeability of components.

More competitive through a wide use of standard proprietary components.

Common set and engine components allow a wide degree of interchangeability throughout range.

Virtually any make of generator may be incorporated in the sets.

Sets available from bare power plants to completely self-contained trailer mounted fully canopied units.

Youve a specification? -It will surprise us if we can't meet it!

Write now for fully illustrated and comprehensive free literature on the New Range.

HENRY MEADOWS LIMITED

ELECTRICAL EQUIPMENT DIVISION,

FALLINGS PARK, WOLVERHAMPTON

Telephone : Wolverhampton 31921

Telegrams and Cables : OUTPUT, Wolverhampton

London Office: 37/41 BEDFORD ROW, LONDON, W.C.1 HOLBORN 6881/5

AN ASSOCIATED BRITISH ENGINEERING COMPANY

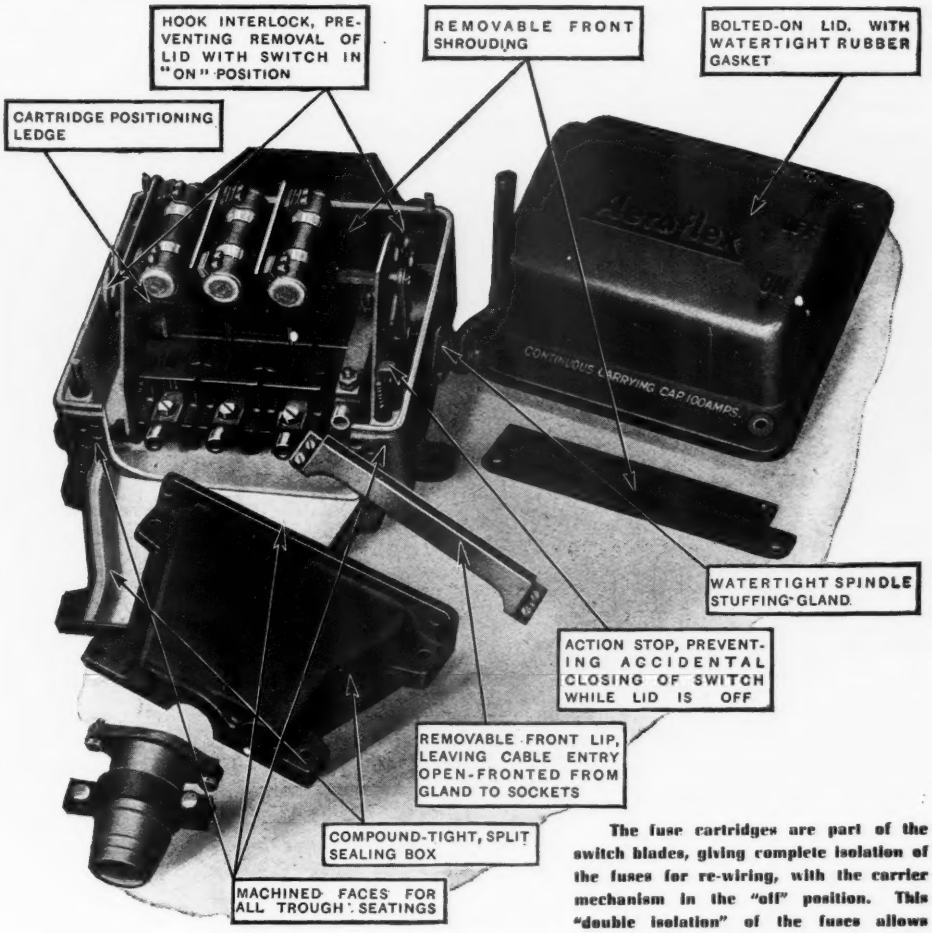
MID 74

Aeroflex
HOPE'S PATENTS

CHASSIS TYPE FUSE-SWITCHES

TYPE FL 30 • 60 • 100 • 150 • 300 • 400 • 600 AMP

FOR AEROFLEX ENERGY LIMITING CLASS P 46KA BREAKING CAPACITY RE-WIREABLE CARTRIDGE FUSE LINKS

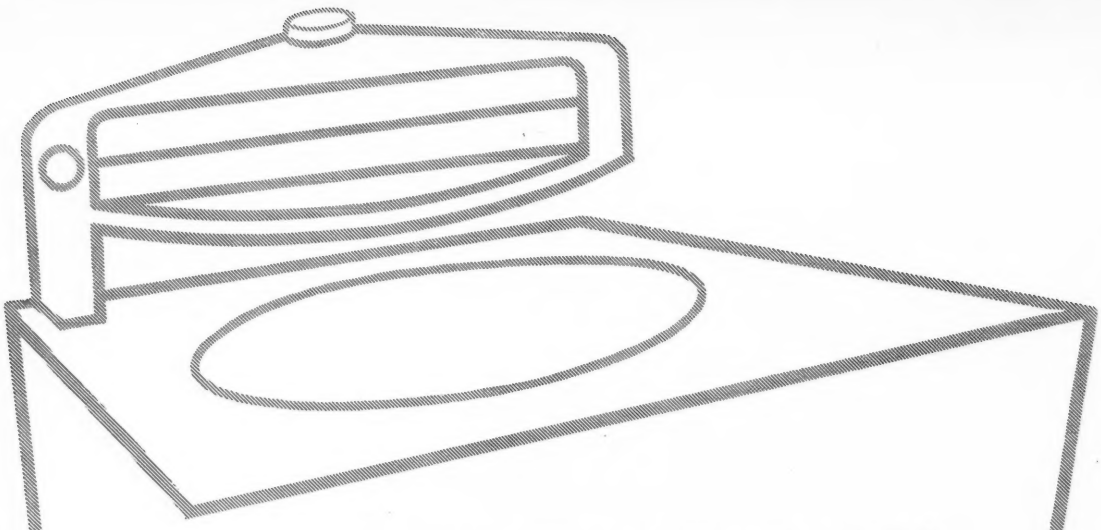

HOOK INTERLOCK, PREVENTING REMOVAL OF LID WITH SWITCH IN "ON" POSITION
REMOVABLE FRONT SHROUDING
BOLTED-ON LID, WITH WATERTIGHT RUBBER GASKET
CARTRIDGE POSITIONING LEDGE
Aeroflex
CONTINUOUS CARRYING CAP. 100 AMPS.
WATERTIGHT SPINDLE STUFFING GLAND
ACTION STOP, PREVENTING ACCIDENTAL CLOSING OF SWITCH WHILE LID IS OFF
REMOVABLE FRONT LIP, LEAVING CABLE ENTRY OPEN-FRONTED FROM GLAND TO SOCKETS
COMPOUND-TIGHT, SPLIT SEALING BOX
MACHINED FACES FOR ALL TROUGH SEATINGS

The fuse cartridges are part of the switch blades, giving complete isolation of the fuses for re-wiring, with the carrier mechanism in the "off" position. This "double isolation" of the fuses allows "top or bottom" entry regardless of the direction of the incoming cable. Illustrated technical literature on request

Parmiter Hope & Sugden Ltd

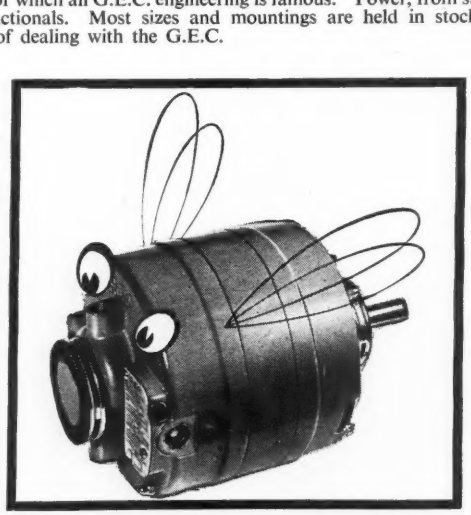
FLUVENT ELECTRICAL WORKS MANCHESTER 12

London: 34 Victoria Street, S W.1. Glasgow: 5 Somerset Place, C.3. · Birmingham: 39/41 Carrs Lane, 4.



The Busy Bee from G.E.C. **puts power where you want it**

Power for many purposes. Power to drive your own plant efficiently, or to add further distinction to the equipment you make and sell. Power. As much (up to 1 h.p.) or as little as you need, in a wide range of mountings, but always with the reliability for which all G.E.C. engineering is famous. Power, from sturdy, dependable G.E.C. Fractionals. Most sizes and mountings are held in stock—that's another advantage of dealing with the G.E.C.



G.E.C. manufacture many types and sizes of domestic appliance motors in large quantities—consult us at the design stage of your new product so that we can help you to choose the right motor for the job.

Fully detailed illustrated publication on application.

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Classified Advertisements

CLASSIFIED advertisements are PREPAID at 3/6 per line (approx. 6 words) per insertion. Where an advertisement includes a Box Number there is an additional charge of 1/-.

DISPLAYED CLASSIFIED:—48/- per inch. Cheques and Postal Orders should be crossed and made payable to ELECTRICAL REVIEW PUBLICATIONS LTD.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

REPLIES to Box Numbers should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1, but if not to be delivered to any particular firm or individual they should be accompanied by instructions to this effect, addressed to the Manager of the ELECTRICAL REVIEW. Replies in such cases cannot be returned. The name of an advertiser using a Box Number will not be disclosed.

ADVERTISEMENTS are accepted up to **First Post on Monday** of the week of issue and should be addressed to ELECTRICAL REVIEW, Classified Advertisement Department, Dorset House, Stamford Street, London, S.E.1.

Original testimonials should not be sent with applications for employment

CHRISTMAS

Classified Advertisements for the issue of 20th December should reach us by FIRST POST on FRIDAY, 13th DECEMBER

OFFICIAL NOTICES, TENDERS, ETC.

WELWYN GARDEN CITY URBAN DISTRICT COUNCIL

New Water Source

Remote Control Cable

SUBJECT to the approval of the Minister of Housing and Local Government the Council intend to develop a New Water Source at Fulling Mill, Welwyn, Herts.

Tenders are invited for the provision of 2,000 lin. yards of multi-core cable and ancillary equipment.

Copies of the specification and form of tender may be obtained from the Engineer and Surveyor, Council Offices, Welwyn Garden City, Herts.

Tenders to be delivered to the undersigned in plain sealed envelopes endorsed "New Water Source, Remote Control Cable," not later than noon, Wednesday, 18th December, 1957.

The Council do not bind themselves to accept the lowest or any tender.

L. J. SLOCOMBE,
Clerk of the Council.

Council Offices,
Welwyn Garden City,
Herts. 1464

NOTTINGHAMSHIRE COUNTY COUNCIL

Street Lighting

TENDERS are invited for the supply and erection of Street Lamp Columns, including Lanterns and Switchgear, on the following traffic islands on the Nottingham-Bawtry road, A.614:—

1. Ollerton Cross Roads.
2. White Post Cross Roads.

Contract documents may be obtained from the County Surveyor, Shire Hall, Nottingham, on payment of a deposit of £2 in respect of each contract made payable to the Nottinghamshire County Council. The deposit will be returned if a bona fide tender is received and not subsequently withdrawn.

Prospective tenderers may inspect the contract documents and drawings at the offices of the County Surveyor during normal office hours.

Tenders should be delivered in the special envelope provided to reach the undersigned by 28th December, 1957.

The Council does not bind itself to accept the lowest or any tender.

A. R. DAVIS,
Clerk of the County Council.

Shire Hall,
Nottingham. 1547

COUNTY BOROUGH OF STOCKPORT

College for Further Education, Phase 1

APPLICATIONS for invitation to tender required from:—

1. HEATING ENGINEERS for mechanical engineering services comprising large-scale heating, H.W.S. and ventilation installations.
2. ELECTRICAL ENGINEERS for installations comprising switchgear, lighting, power, low voltage, etc.

Tenders will be invited from selected list. Applications in writing to Borough Architect, Town Hall, Stockport, by 21st December, 1957. 1546

COUNTY BOROUGH OF SOUTHAMPTON

TENDERS are invited from Electrical Contractors for renewal of Electrical Installation at Itchen Grammar School.

Forms and particulars from Borough Architect on written application by 13th December, 1957. R.I.B.A. contract plus supplementary conditions available for inspection.

Tender to Town Clerk, Civic Centre, Southampton, by 10 a.m., 20th January, 1958. 1534

SITUATIONS VACANT

CENTRAL ELECTRICITY AUTHORITY

Headquarters

PRINCIPAL ASSISTANT ENGINEER required in CIVIL ENGINEERING BRANCH, GENERATION DESIGN AND CONSTRUCTION SUB-DEPARTMENT, LONDON, S.E.1, to be responsible for supervising the activities of a number of Senior Assistant Engineers engaged in the critical examination of projects for building and civil engineering works associated with power station construction and for dealing with such other aspects of the work of the branch as may be delegated to him.

Candidates must have wide experience in heavy civil engineering design and construction, some knowledge of building work, and a full knowledge of contracts procedure, including field experience of major contracts. Experience in modern power station construction would be an advantage, and preference will be given to those who are Corporate Members of the Institution of Civil Engineers.

Salary within scale £2,160 - £2,360 p.a., inclusive.

Applications, stating age, qualifications, experience, present position and salary, to D. Moffat, Director of Establishments, Winsley Street, London, W.1, by 31st December, 1957. Quote ref. ER/497. 1515

DRAUGHTSMEN

English Electric,

Whetstone,

Near Leicester.

ELECTRICAL DRAUGHTSMEN with experience of power station electrical layouts are required for interesting work in this field on modern nuclear power stations.

Qualifications up to H.N.C. in Electrical Engineering and several years' electrical D.O. experience are desirable.

Please apply to

C.P.S., 336/7, Strand, London, W.C.2,

quoting Ref. ER.1899D.

1520

YORKSHIRE ELECTRICITY BOARD

No. 3 (Sheffield) Sub-Area

SHEFFIELD DISTRICTS, ASSISTANT CONSUMERS' ENGINEERS (2 posts).

Applicants should have had a sound practical training in the electricity supply or electrical contracting industry and should preferably have qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

They should be capable of carrying out negotiations with consumers for new and additional supplies and have a sound knowledge of tariffs and their appropriate applications. They should have had experience of general load development in the industrial, space heating and catering fields, be fully conversant with the wiring rules and regulations of the I.E.E., be capable of preparing electrical schemes and specifications and have had experience of controlling staff and workpeople.

Salary N.J.B. Class L, Grade 10, £995/£20/£1,055 per annum.

Applications giving full details of age, qualifications and experience, together with the names of two referees should be forwarded to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial Street, Sheffield, not later than 20th December, 1957.

No. 1 (Bradford) Sub-Area

OTLEY DISTRICT, THIRD ASSISTANT DISTRICT ENGINEER.

Applicants should have passed the Associate Membership Examination of the Institution of Electrical Engineers, or hold equivalent qualifications, and have experience in construction, operation and maintenance of high voltage systems, underground cables and overhead lines and substations, and medium low voltage networks.

Candidates should be prepared to reside within the district and undertake standby duties.

Salary N.J.B. Class F, Grade 9, £790/£15/£835 per annum.

Applications giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 1 (Bradford) Sub-Area, Yorkshire Electricity Board, 45/53, Sunbridge Road, Bradford, not later than 20th December, 1957. 1561

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

APPLICATIONS are invited for appointment as FOURTH ASSISTANT ENGINEER (Electrical), Site Office, at Drakelow "B" Generating Station, Near Burton-on-Trent, to assist in the supervision of site construction and erection of the electrical auxiliaries in a modern power station.

Candidates should have had experience in the manufacture, installation or maintenance of one or more of the type of equipment concerned. An engineering qualification would be considered an advantage.

The salary will be in accordance with N.J.B. Agreement, Schedule B, Class AX/EX, Grade 7, commencing in range £810 × £25 to £935 and ultimately rising to £1,035 per annum.

Apply, quoting vacancy number 692MD on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 16th December, 1957. 1557

Situations Vacant (continued)

CITY OF SALISBURY, SOUTHERN RHODESIA

Electricity Department

Power Station Efficiency Engineer (Mechanical Engineer Grade 1)

APPLICATIONS are invited for the above-mentioned fixed establishment post in the Salisbury Municipality Electricity Undertaking on the salary scale £1,575 × £50 to £1,725 p.a. Commencing salary is at the minimum of the grade and no cost-of-living or other allowances are payable.

The successful candidate will be responsible as Efficiency Engineer to the Generation Engineer for the preparation, accuracy and correlation of all technical data required for the efficient control of the generating plant installed in the Salisbury Power Stations. He will also be responsible for the thermal or mechanical testing of plant in accordance with British Standards or standard practice.

The position calls for a knowledge of the theory of electrical, fluid and temperature measurement techniques as applied to thermal power station plant testing procedure and practical experience in the operation of electrical generating plant is essential.

Applicants should be Chartered Mechanical Engineers.

The appointment will be subject to the Council's service and leave regulations and the successful applicant will be required to furnish a satisfactory medical certificate of fitness. He must also be able to comply with the requirements of the immigration authorities.

Candidates are requested to submit full particulars of their qualifications, training and experience, which should include details of positions held and salaries received. Particulars of age, place of birth, nationality and marital state should also be given, and copies of not more than three recent testimonials may be included.

Further particulars regarding conditions of service, leave entitlement, allowances towards travelling and removal expenses are obtainable from Davis & Soper Ltd., 52 & 54, St. Mary Axe, London, E.C.3, to whom applications must be submitted on or before 20th December, 1957. 1506

CENTRAL ELECTRICITY AUTHORITY

East Midlands Division

APPLICATIONS are invited for the following appointments in this Division :—

SENIOR ASSISTANT ENGINEER, GENERATION (Operation) DEPT., OPERATIONAL RESEARCH SECTION, DIVISIONAL HEADQUARTERS (Vacancy No. 213/57/ER).

Applicants should be fully qualified electrical or mechanical engineers, and previous experience of operational research is desirable, but not essential, as there will be opportunities for training in the technique.

Salary will be in accordance with Class AX/EX, Grade 3 (£1,330-£1,595 per annum) of Schedule B of the National Joint Board Agreement.

Closing date for receipt of applications, 18th December, 1957.

STATION SHIFT CONTROL ENGINEER, CASTLE DONINGTON POWER STATION (Vacancy No. 209/57/ER).

Applicants should have had a sound training and practical experience in a modern power station. The possession of a Higher National Certificate in Electrical Engineering, or its equivalent, would be an advantage.

Salary will be in accordance with Class L, Grade 10 (£995-£1,055 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 18th December, 1957.

GENERAL ASSISTANT ENGINEER (Shift Control Duties), NORTHAMPTON POWER STATION (Vacancy No. 210/57/ER).

Applicants should have served an apprenticeship or had practical training suitable to the industry and should possess a sound general and technical education. Possession of an Ordinary National Certificate in Electrical Engineering is a minimum requirement.

Salary will be within the range (£540-£680 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 24th December, 1957.

SHIFT CHARGE ENGINEER, WARWICK POWER STATION (Vacancy No. 214/57/ER).

Applicants should be qualified engineers and should have had experience in the operation of steam turbine and boiler plant.

Salary will be in accordance with Class E, Grade 7 (£835-£880 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 24th December, 1957.

THIRD ASSISTANT ENGINEER (Electrical), GENERATION (Construction) DEPT. (Vacancy No. 215/57/ER).

Applicants should have had a fundamental training in electrical engineering, including workshops, and should preferably have had experience in the manufacture, erection and maintenance and operation of electrical plant as installed in modern power stations. Preference will be given to candidates who possess a degree or are Graduate Members of the Institution of Electrical Engineers.

Salary will be within Class AX/EX, Grade 4 (£895-£1,140 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 24th December, 1957.

STATION CHEMIST, BURTON-ON-TRENT POWER STATION (Vacancy No. 216/57/ER).

Previous experience in a power station laboratory is essential and candidates should hold the Higher National Certificate in Chemistry.

Applicants must be familiar with the sampling and analysis of coal, water and oil and the interpretation of the analytical results.

Salary will be in accordance with Class E, Grade 7 (£835-£880 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 24th December, 1957.

STATION SUPERINTENDENT AND DEPUTY STATION SUPERINTENDENT, HIGH MARNHAM POWER STATION (Vacancy No. 218/57/ER).

Applications are invited for the positions of Station Superintendent and Deputy Station Superintendent at the High Marnham Power Station, which is now under construction. The ultimate capacity of this station will be 1,000 MW.

This power station is situated in a rural area on the River Trent, approximately 14 miles south of Gainsborough and 5 miles east of Tuxford, in the county of Nottinghamshire.

Candidates must have served a recognised engineering apprenticeship and have had wide experience in a responsible position in the administration, operation and maintenance of a modern high-pressure power station.

It is desirable that applicants should possess qualifications admitting to Corporate Membership of the Institution of Electrical Engineers and/or Institution of Mechanical Engineers.

The commencing salary for the Station Superintendent will be in accordance with Scale D, Grade 5 (£2,100-£2,300 per annum) of the National Joint Managerial and Higher Executive grades and the conditions of service will be those agreed by that committee.

The salary for the Deputy Station Superintendent will be in accordance with Class L, Grade 3 (£1,685-£1,790 per annum) of the National Joint Board Schedule, and the conditions of service for this post will be those agreed by the National Joint Board.

The closing date for the receipt of applications will be Monday, 21st December, 1957.

The appointments will be pensionable within the provisions of the Central Electricity Authority and Area Boards (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT, which may be obtained from the Divisional Establishments Officer, Central Electricity Authority, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. PLEASE QUOTE VACANCY NUMBER.

L. F. JEFFREY,
Divisional Controller.

28th November, 1957. 1537

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts :—

North Staffordshire Sub-Area

FIRST ASSISTANT DISTRICT ENGINEER (Congleton District).

Applicants should have had a sound technical training and experience in all branches of distribution work, including operation, maintenance and construction of H.V. and L.V. distribution systems, substations, etc. Technical qualifications desirable. Salary £885/£930 per annum (N.J.B. Grade D.5).

SECOND ASSISTANT DISTRICT ENGINEER (Congleton District).

Applicants should have experience in planning, construction, operation and maintenance of medium and high-voltage distribution systems including reinforcements and extensions. Technical qualifications desirable. Salary £790/£835 per annum (N.J.B. Grade D.7).

Apply, by letter, within fourteen days, stating age, experience, present position and salary to Mr. H. A. P. Caddell, Sub-Area Manager, Midlands Electricity Board, P.O. Box No. 4, 234, Victoria Road, Fenton, Stoke-on-Trent.

Birmingham and District Sub-Area

GENERAL ASSISTANT DISTRICT COMMERCIAL ENGINEER (Solihull District).

Duties will include advising consumers in respect of domestic and commercial electrical equipment, estimating and contracting work. A good knowledge of electrical installation practice is required, together with good commercial ability. Technical qualifications desirable. Salary N.J.B. Grade F.14 (£540/£585 per annum) to Grade F.11 (£685/£730 per annum) according to qualifications and experience.

Apply, by letter, within fourteen days, stating age, qualifications, experience and present salary to Emil Braathen, Sub-Area Manager, Midlands Electricity Board, 14, Dale End, Birmingham, 1.

Worcester and District Sub-Area

DRAUGHTSMAN (Stratford-on-Avon District).

The successful applicant will be responsible for drawing office and surveying duties in the District, including the maintenance of all mains records. Salary £595/£715 per annum (N.J.B. Grade D.6).

Apply, by letter, within fourteen days, to Mr. R. Mallet, Sub-Area Manager, Midlands Electricity Board, Whittington, Worcester.

Central Gloucestershire Sub-Area

THIRD ASSISTANT DISTRICT ENGINEER (Stroud District).

Duties involve the construction, maintenance and operation of H.V. and L.V. mains and substations, and applicants should have had experience in the planning of system reinforcements and mains extensions. Technical qualifications desirable. Salary £740/£785 per annum (N.J.B. Grade E.9).

Apply, by letter, within fourteen days, stating age, experience, present position and salary, to Mr. S. Raybould, Sub-Area Manager, Midlands Electricity Board, 126, London Rd., Gloucester.

A. STEPHENS,
Secretary. 1552

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

APPLICATIONS are invited for the appointment as FOURTH ASSISTANT ENGINEER (Mechanical), Site Office, at Drakelow "B" Generating Station, Near Burton-on-Trent, to assist in the supervision of site construction and erection of turbo-alternator condensing and feed heating plant, boilers, coal and ash handling plant, etc.

Candidates should have had experience in the manufacture, erection or maintenance of one or more of the type of plant mentioned. An engineering qualification would be considered an advantage.

The salary will be in accordance with N.J.B. Agreement, Schedule B, Class AX, Grade 7, commencing in range £810 × £25 to £935 and ultimately rising to £1,035 per annum.

Apply, quoting vacancy number 691MD on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham 13, by 16th December, 1957. 1556

CENTRAL ELECTRICITY AUTHORITY

London Division

APPLICATIONS invited for following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A or B. Salary includes London allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. for posts (a) and Corporate Membership for posts (b) an advantage.

(a) STATION SHIFT CONTROL ENGINEER, BLACKWALL POINT POWER STATION
(Vacancy No. 57/1083).

Sound technical training with experience in control and operation of modern generating plant and E.H.T. switchgear. Salary Class F, Grade 10 = £780 plus £74 shift p.a.

(a) THIRD ASSISTANT ENGINEER
(Efficiency and Testing),
DIVISIONAL TESTING AND EFFICIENCY SECTION,
GENERATION (Operation) DEPT.,
DIV. H.Q. (Vacancy No. 57/1084).

Good technical education and experience in testing and operation of power stations mechanical plant, with knowledge of instrumentation a qualification. Salary Class AX/EX, Grade 6 = £945/£1,190 p.a.

(b) MAINTENANCE ENGINEER
(Electrical),
DEPTFORD WEST POWER STATION
(Vacancy No. 57/1085).

Sound technical training with wide experience of power station electrical maintenance work, including staff supervision. Salary Class J, Grade 7 = £1,115 p.a.

Applications, quoting vacancy number, to (or on form from) Central Electricity Authority, London Division, P.O. Box 136, London, W.1, by 16th December, 1957. 1516

TELECOMMUNICATION ENGINEERS

Are You Looking for an Interesting Job?

A. T. & E. Co. Ltd., Liverpool,
have vacancies for

EQUIPMENT ENGINEERS
with automatic telephone exchange and kindred experience to prepare floor plans, equipment quantities, rack layouts, etc., from customers' specifications.

CIRCUIT ENGINEERS
to design circuits for auto and automanual exchanges and electronic switching purposes.

LABORATORY ENGINEERS
for set-up and test of circuits and equipment prior to manufacture.

DRAUGHTSMEN
with experience in light electrical and mechanical apparatus, wiring and equipment.

If you are ambitious and want a change, write to us, giving full details of your work, age and experience, and let us decide if it would be to your advantage to come for an interview. This would be at our expense, and arranged at a mutually convenient time.

The positions are on permanent staff with generous pension fund (contributory) and full range of welfare activities, including medical and dental facilities.

Assistance will be given with housing and with removal expenses.

Write to

The Personnel Manager
AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.
Strowger Works
Edge Lane, Liverpool, 7

1458

CENTRAL ELECTRICITY AUTHORITY

APPLICATIONS are invited for the following posts :—

GENERAL ASSISTANT ENGINEERS, NORWICH GENERATING STATION
(Ref. S.V. No. 991).

Salary Class F, Grade 13, £590 × £15 to £635 per annum plus 10% shift allowance.

The duties of the successful applicant will include assisting in the control room on shift and other operation and investigation duties. Preference will be given to applicants who have had previous experience in a generating station and who have reached the standard of the Ordinary National Certificate in Electrical Engineering or its equivalent.

GENERAL ASSISTANT ENGINEERS, RYE HOUSE GENERATING STATION
(Ref. S.V. No. 992).

Salary Class G, Grade 14, £590 × £15 to £635 per annum, or Grade 15, £540 × £15 to £585 per annum plus 10% shift allowance.

Duties include assisting in the electrical control room and experience in the technical operation of electrical, boiler house and turbine house plant, testing, etc., in a generating station, and provide a suitable basis for promotion to higher technical grades.

Manual workers in skilled grades with suitable technical training will be considered. Previous experience in a generating station and/or technical training to the standard of the Ordinary National Certificate or its equivalent will be an advantage.

STATION SHIFT CONTROL ENGINEER, GREAT YARMOUTH GENERATING STATION
(Ref. S.V. No. 993).

Salary Class D, Grade 10, £635 × £15 to £680 per annum plus 10% shift allowance.

Applicants should have reached the standard of Ordinary National Certificate in Electrical Engineering, or its equivalent, have experience in the operation of a switchboard at a generating station, and be fully conversant with high-voltage switching operations and protective systems.

Applications, quoting the appropriate S.V. number, stating age, qualifications and experience, should be sent to the Controller, Central Electricity Authority, Eastern Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts, by 14th December, 1957.

W. N. C. CLINCH,
Controller. 1538

ARMATURE WINDING AND GENERAL ELECTRICAL REPAIRS

AN old-established and progressive firm of electrical engineers in the Midlands require a WINDING AND REPAIR SHOP MANAGER capable of taking complete charge of department.

Must have thorough knowledge of modern repair shop technique in rotating electrical machinery, transformers, coil-winding and mechanical applications, together with administration and office routines.

A man with good experience of labour control and customer relations preferred.

A fine progressive post for the right type of engineer, with a good salary, bonus and pension rights.

Box 1508.

A WINDING SHOP FOREMAN with similar experience is also required.

Box 1508a.

IMPORTANT BELGIAN COMPANY

requires for the Middle East an
ELECTRICAL ENGINEER
with university degree or equivalent diploma. Must have experience of erection and design of high-tension lines and substations. Monthly salary in order of £300. Knowledge of French desirable.

Write giving full details of age, education and experience to—Office de Publicité "H.K.," 16, rue Marcq, Brussels (Belgium). 1566

CITY OF SALISBURY, SOUTHERN RHODESIA

Electricity Undertaking

Vacancy for Test Room Assistant (Meters)

APPLICATIONS are invited for the fixed establishment post of Technical Assistant Grade 2 in the Test Section of the abovementioned undertaking. Salary scale is £1,100 × £50 to £1,250 p.a., commencing salary at the minimum. No cost-of-living or other allowances are payable.

Applicants must be thoroughly experienced in all types of meter testing, particularly high-tension, transformer-operated, polyphase equipments, both kW and kVA, and should be capable of carrying out all duties in connection with a standardising laboratory.

The main duties of this post are :—

(a) Testing and calibrating high-tension and special types of metering.
(b) Standardising instruments and sub-standard meters against potentiometer equipments.
(c) Ratio and phase angle testing of instrument transformers.
(d) Testing all types of instruments and meters, and general supervision of metering work.

The successful candidate must be able to comply with the requirements of the immigration authorities, and will be required to submit to the Council a satisfactory medical certificate of fitness.

Applicants should submit full particulars of their technical education, qualifications, if any, training and experience. Details of age, place of birth, nationality and marital state should be given, and copies of not more than three recent testimonials may be included.

Further particulars regarding conditions of service, leave entitlement, allowances towards travelling and removal expenses, etc., are obtainable from Davis & Soper Limited, 52 & 54, St. Mary Axe, London, E.C.3, to whom applications must be submitted on or before 27th December, 1957. 1507

FEDERATION OF RHODESIA AND NYASALAND

Federal Power Board

Appointment of Operations Controller

THE Board require the services of an OPERATIONS CONTROLLER who should be a fully qualified Electrical Engineer with wide knowledge of all aspects of the operation of electricity supply systems, including the commercial aspects, and who should possess executive experience.

The Board are at present constructing at the Kariba Gorge on the Zambezi a large dam and power station having an initial capacity of 500 MW and an ultimate capacity of at least 1,200 MW. The Board are also constructing about 930 miles of 330-kV transmission line to connect the Kariba power station with a number of thermal stations in the Federation. The Operations Controller is required in connection with the operation of this integrated system.

Salary £3,500 per annum. There is a pension scheme which the successful applicant will be required to join.

Applications should be posted so as to reach the Secretary, Federal Power Board, Reliance House, P.O. Box 630, Salisbury, Southern Rhodesia, not later than 31st January, 1958.

1297

Situations Vacant (continued)

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT ENGINEER,
Dover District.

Salary £740 × £15 to £785 p.a. under N.J.B. Class E, Grade 9. Superannuable. Applicants should possess the Higher National Certificate in Electrical Engineering or equivalent qualification and must be experienced in the construction, operation and maintenance of overhead and underground distribution systems up to 11 kV. The appointment will involve standby duty.

Applications, naming 2 referees, to R. G. Widgery, A.M.I.E.E., District Manager, SEEBOARD, Ladywell, Dover, by 18th December, 1957.

LADY DEMONSTRATOR,
West Kent District.

Salary £500 × £20 to £600 p.a. plus London weighting under N.J.C. Grade 1. Superannuable. Applicants should possess a recognised diploma or certificate in domestic science, also E.A.W. Certificate. The successful applicant will be required to conduct lectures and demonstrations, advise consumers, and generally assist in service centres.

Applications, on forms from District Manager, West Kent, SEEBOARD, 270, High Street, Orpington, Kent, by 18th December, 1957.

CARTOGRAPHIC DRAUGHTSMAN,
Dorking and Epsom District.

Salary £500 × £20 to £600 per annum under Grade 1 of the N.J.C. Agreement. Superannuable.

38-hour week with alternative Saturdays free. Generous leave and sick pay schemes.

Applicants should have experience in the preparation of mains record plans, reproduction of ordnance survey maps and general drawing office routine.

Applications, naming 2 referees, on forms from C. L. B. White, District Manager, SEEBOARD, 56, South Street, Dorking, by 18th December, 1957.

A. L. BURNELL,
Secretary.
1571

YOUNG ELECTRICAL ENGINEERS

Age 22-25

required for modern Railway Signal Engineering, including circuit design. Knowledge electronics useful but not essential. Candidates should possess H.N.C. Electrical Engineering, but non-possession would not rule out otherwise suitable applicant.

Training period allowed to acquire specialist knowledge.

Commencing salary £725 per annum and upwards depending upon age, qualifications and experience. Permanent appointment, G.E.C. pension fund, five-day week.

Apply in writing to :—

Signal Engineer

SIEMENS AND GENERAL ELECTRIC RAILWAY SIGNAL CO. LTD.

East Lane, Wembley

1549

SOUTH WALES ELECTRICITY BOARD

THIRD ASSISTANT ENGINEER required in the Sub-Area Engineering Department, Central Sub-Area.

Salary Class L, Grade 10 (£995/£1,055) of the N.J.B. Agreement.

Applications stating age, present position and salary, qualifications, experience and three referees should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 16th December, 1957. 1572

CENTRAL ELECTRICITY AUTHORITY

South Western Division

GENERAL ASSISTANT ENGINEER (Control) at Hayle Power Station.

Superannuation scheme. Salary N.J.B. Class F, Grade 14, £540 × £15 to £585, plus 10% for shift duties.

Applicants should possess O.N.C. in Electrical or Mechanical Engineering or equivalent. Previous generating experience considered an advantage.

Closing date 13th December, 1957.

STATION SHIFT CONTROL ENGINEER at Bath Power Station.

Superannuation scheme. Salary N.J.B. Class D, Grade 10, £635-£680, plus 10% for shift duties.

Candidates should possess good technical qualifications and have had training and experience in the control and operation of steam generating plant and main switchgear.

Closing date 18th December, 1957.

ASSISTANT ENGINEER (Handling) at Newton Abbot Power Station.

Superannuation scheme. Salary N.J.B. Class F, Grade 11, £685-£730.

Duties will be mainly in connection with coal stocking, coal movements and ash disposal. Previous experience of similar duties will be an advantage.

Closing date 18th December, 1957.

Applications on Form A.E.6/ACT, obtainable from the Divisional Secretary, 26, Oakfield Road, Bristol, 8. 1554

ROLLS-ROYCE

Aero Engine Division

require

SHIFT CHARGE ENGINEERS

for operating electro-mechanical plant for altitude testing of aero gas turbine engines at Derby.

The installation comprises six 20,000-h.p. motor compressor sets, cooling and regeneration turbines, heat exchangers, refrigeration plant, cooling towers, electro-hydraulic and pneumatic control systems and ancillary services. The total installed h.p. is 150,000 with a supply voltage of 33,000 v.

Applicants should have had sound technical training and practical experience in the operation of this type of equipment. Appropriate technical qualifications would be an advantage.

The salary, which is progressive, commences at £1,085 per annum, plus shift allowances.

Applications will be treated in the strictest confidence and those selected for interview could be seen either in Derby or elsewhere as convenient.

Candidates should write for an application form to :—

The Manager
Technical Administration (CN)
Aero Division
ROLLS-ROYCE LIMITED
P.O. Box 31, Derby.

1513

SOUTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for three vacancies for ASSISTANT ENGINEERS in District 222 (Neath) in the West Central Sub-Area of the Board.

Salary Class E, Grade 11 (£635/£680) of the N.J.B. Agreement.

Applications stating age, present position and salary, qualifications, experience, and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 16th December, 1957. 1494

REACTOR RESEARCH PROGRAMME

ENGINEERS
for
(1) OPERATION AND MAINTENANCE OF RESEARCH REACTORS.
(2) SITE SERVICES, OPERATION AND MAINTENANCE.
(3) ELECTRICAL AND MECHANICAL DESIGN OF PROTOTYPE AND EXPERIMENTAL EQUIPMENT.
(4) MANUFACTURE OF EXPERIMENTAL EQUIPMENT.

THE Engineering Division of the Research Group of the United Kingdom Atomic Energy Authority is forming a nucleus staff to man and commission a Research and Development Establishment in DORSET.

A wide range of posts will be available in this project, but applications are at this time being sought from those interested in joining for initial training at A.E.R.E., Harwell. Candidates should have served a recognised engineering apprenticeship or have had equivalent training, and be Corporate Members of a senior engineering institution. The possession of an engineering degree would be an advantage.

Posts are available at the following levels :—

£815 (age 25)	to £1,270 (Eng. III).
£1,300	to £1,740 (Eng. II).
£1,790	to £2,080 (Eng. I).

Please send a postcard to the RECRUITMENT OFFICER (993Y/48), A.E.R.E., HARWELL, DIDCOT, BERKS, for application form and further details. 1495

APPLICATIONS are invited for pensionable posts as

EXAMINERS
in the
PATENT OFFICE

to undertake the official scientific, technical and legal work in connexion with Patent applications.

Age at least 21 and under 35 years on 1st January, 1957, with extension for regular Forces' service.

Candidates must have 1st or 2nd Class Honours in Physics, Organic or Inorganic Chemistry, Mechanical or Electrical Engineering or in Mathematics, or an equivalent qualification, or have achieved a professional qualification, e.g., A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.R.I.C. For a limited number of vacancies candidates with 1st or 2nd Class Honours degrees in other subjects—scientific or otherwise—will be considered. Exceptionally, candidates otherwise qualified by high professional attainments will be considered.

Starting pay for 5-day week of 42 hours in London between £605 and £1,120 (men), according to postgraduate (or equivalent) experience and National Service. Maximum of scale £1,345. This salary scale is being increased by approximately 5%. Women's pay above £605 slightly lower but is being raised to reach equality with men's in 1961. Good prospects of promotion to Senior Examiner rising to £2,000 (under review) and reasonable expectation of further promotion to Principal Examiner.

Further particulars from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting S.128/57 and stating date of birth. Application forms should be returned not later than 31st December, 1957. 1496

EASTERN ELECTRICITY BOARD

Fens Sub-Area, 153/57.R

Fitter (Electrical), St. Neots

APPLICATIONS are invited for the position of FITTER (Electrical) to operate within the Construction Department based on St. Neots. Experience in installation and maintenance of H.V. and L.V. switchgear, transformers, etc., is essential.

Rate of pay, at present 4s. 7½d. per hour for a 44-hour week, and conditions of service will be in accordance with the National Joint Industrial Council Agreement for the Electricity Supply Industry.

Apply by letter within seven days to the Secretarial Officer, Fens Sub-Area, Eastern Electricity Board, Milton, Cambridge. 1551

CENTRAL ELECTRICITY AUTHORITY

Southern Division

APPLICATIONS are invited for the following positions:—

GRADE 10 ENGINEERS,
POOLE GENERATING STATION
(S/13.972).

Those appointed will be given opportunities to gain experience on oil-fired plant operation, control room duties and maintenance work. Operating experience of modern generating station plant is essential.

Salary N.J.B. J/10, £885-£930.

GRADE 12 ENGINEERS,
MARCHWOOD GENERATING STATION
(S/13.973).

Those appointed may be required to undertake shift operational duties, to assist on maintenance work, or to perform general station duties. Previous experience of modern generating station plant is desirable.

Salary N.J.B. K/12, £835-£880.

For both vacancies applicants should have had a sound technical training and should possess qualifications leading to corporate membership of an appropriate professional institution or hold equivalent qualifications.

Special application forms, obtainable only from P. D. A. Oliver, Divisional Secretary, Central Electricity House, High Street, Portsmouth, should be returned by 18th December, 1957. 1553

ENGLISH ELECTRIC

OFFERS CAREERS TO YOUNG MEN HAVING AT LEAST O.N.C. (ELECTRICAL) AND PRACTICAL EXPERIENCE.

A Training Course is being arranged on the company's heavier range of Switchgear.

On satisfactory completion, appointments will be made to the Applications Section or to the Circuit Breaker Design and Development Section of the Switchgear Engineering Department, Stafford. The former department is actively engaged in the engineering of switchgear schemes relating to a variety of generation and utilisation projects, while the latter is engaged on long-term development of circuit breaking equipment.

Generous salaries will be paid during training. Help will be given with removal expenses and accommodation.

All applications will be treated confidentially.

Write giving full details to Central Personnel Services, 336/7, Strand, London, W.C.2, quoting Ref. ER.1201B.

356

PORT OF LONDON AUTHORITY

THE PORT OF LONDON AUTHORITY invite applications for the position of ASSISTANT ENGINEER (Electrical) at a salary of £1,265 rising by annual increments to £1,715 per annum. Commencing rate according to age and experience.

Candidates, who must be British subjects and Corporate Members of the Institution of Electrical Engineers, should have served a recognised apprenticeship with one of the major electrical manufacturing firms and should have experience in the specification, installation, operation and maintenance of the electrical equipment of a dock or harbour undertaking or heavy industrial organisation, including H.V. and L.V. distribution systems, rectifying plant, A.C. and D.C. cranes and pumping plant, large lighting schemes and V.H.F. radio-telephony.

The successful applicant will be required to become a member of the Port Authority's contributory superannuation scheme. In certain cases existing pensionable service is transferable.

Application forms may be obtained from the Establishment Officer, Port of London Authority, Trinity Square, London, E.C.3. 1352

CONTRACTS ENGINEERS

A. REYROLLE & COMPANY LTD., of Hebburn, County Durham, who are the largest firm of switchgear specialists in the world, have vacancies for CONTRACTS ENGINEERS both for home and overseas contract work on E.H.V. switchgear. In addition, vacancies also exist for CONTRACTS ENGINEERS to handle work in connection with major industrial installations and medium-voltage switchgear.

The appointment would be for work at Hebburn, and it is customary for the company to appoint engineers for duties in the overseas and home area offices from engineers trained at Hebburn.

The work requires initiative and affords the engineer individual responsibility. It is interesting and varied and calls for ability to conduct both technical and commercial negotiations. The desirable qualifications are therefore a Degree or a Higher National Diploma or Higher National Certificate, but candidates having Ordinary National Certificate who are still proceeding with studies could be considered specially. Applicants need not have specialised previously in switchgear, and if necessary suitable introductory training would be arranged.

Applications, giving full particulars of technical training and previous experience, should be forwarded to the Contracts Manager, A. Reyrolle & Co. Ltd., Hebburn, Co. Durham, marked "Personal." 1448

INSTRUMENT ENGINEER

required by large Oil Company for work in Middle East. Applicants should have served a full apprenticeship and possess H.N.C.

The man selected will be required to calibrate and repair all types of electrical instruments governing the generation of electricity and the protection of circuits, both single and three-phase, including protective relays of all types, kilowatt indicators, kilowatt hour meters, kilovar indicators, power factor indicators, voltage regulators and frequency meters. In addition he would be responsible for the calibration and repair of test equipment such as A.V.O.s, Meggers, Selectest, etc.

Service will be on three-year contracts with pensionable pay not less than £1,050 per annum plus large local allowance. Paid home leave with free passages every two years. Fully furnished air-conditioned quarters at nominal rental. Bachelor preferred owing to shortage of married accommodation. Age limit 35.

Write giving full details, quoting No. 751, to Box 1324, c/o Charles Barker & Sons Ltd., Gateway House, London E.C.4. 1510

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

FOURTH ASSISTANT ENGINEER is required in the Protective Gear Section of the Technical Department. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 8, commencing in range £710-£835, ultimately rising to £935 per annum.

A university degree, Higher National Certificate or equivalent qualification is desirable. Some knowledge of protective gear is required, and preferably experience with a switchgear manufacturer.

Apply, quoting vacancy number 694MD on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 19th December, 1957. 1558

ELECTRIC MOTOR SALES

REPRESENTATIVES required by outstandingly progressive company for sales of motors from fractional to 600 h.p.

Best possible prospects, incentives and conditions for top grade men.

Applications to:—

The Managing Director,
NEWMAN INDUSTRIES LIMITED,
Yate, Bristol.

1568

NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments:—

Wear Sub-Area

FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER, Chester-le-Street. Applicants should preferably be Graduate or Corporate Members of I.E.E. or possess equivalent qualifications and have experience in utilisation of electrical energy in commercial and domestic premises, knowledge of installation work and be conversant with tariffs, sales and all aspects of consumers' service.

Salary Schedule A, Class F, Grade 5, £995/£1,055. N.J.B. conditions of service.

York Sub-Area

SECOND ASSISTANT DISTRICT ENGINEER, Whitby District. Applicants should preferably have had experience of networks supplying urban and rural areas and in supervision of direct labour and contractors on construction work.

Salary Schedule A, Class C, Grade 7, £740/£785. N.J.B. conditions of service.

Applications, stating age, qualifications and experience, to be received by the Assistant Secretary (Establishments), North Eastern Electricity Board, G.P.O. Box 117, Carliol House, Newcastle upon Tyne, within ten days of the appearance of this advertisement. 1570

ELECTRICIANS

Day and Night Shifts

A LARGE number of skilled Electricians are wanted for installations in HUNTER aircraft.

Applications welcomed from men with good experience in R.A.F. and Fleet Air Arm and from all capable of high-quality work.

Good rates and bonuses and all facilities.

Write or call, including Saturday mornings :—

The Personnel Officer
HAWKER AIRCRAFT LIMITED
Richmond Road, Kingston-on-Thames, Surrey
(Telephone : KINgston 7741)

1511

AUTOMOTIVE ELECTRICIAN

required
for immediate employment in oilfields in
VENEZUELA.

Would be required to take charge of electrical repair shops of Vehicle Overhaul Department, also as technical adviser to Transport Department on all auto and marine electrical matters.

Candidate must be primarily a practical man, able to work without supervision, and competent to write a good technical report. A minimum academic qualification of National Certificate necessary. Essential to have at least six years as a supervisor or foreman in charge of auto electricians on electrical repair work and be familiar with the electrical side of British and U.S. light and heavy vehicle and earth moving equipment, cranes and test gear.

Knowledge of marine electrical work and fuel injection equipment useful. Generous overseas U.S. dollar salary. Tours two and three years with local leave and paid home leave end of each tour. Single or married man considered. Approximate age 30/35 years. All travelling expenses paid for interviews.

Please write giving full details experience, qualifications, age, etc., to Box Z.F.291, Deacons Advertising, 36, Leadenhall Street, London, E.C.3. 1514

BRITISH KLOCKNER SWITCHGEAR LIMITED

Chertsey, Surrey

TECHNICAL SALES ENGINEERS required for London and Home Counties. Knowledge of motor control gear; sales experience preferred but not essential. Apply giving full particulars to—Managing Director. 166

Situations Vacant *(continued)*

CHIEF ELECTRICAL DESIGNER

CROMPTON PARKINSON LTD.

DONCASTER, YORKS

invite applications for the post of
CHIEF ELECTRICAL DESIGNER
for F.H.P. Motors.

The company are looking for a man with imagination and initiative backed by a good engineering degree. The work will include the design and development of new ranges of A.C. and D.C. motors, and practical motor design experience is essential.

The salary offered will be generous, in keeping with the post advertised and the qualifications and experience of the successful candidate.

Conditions of employment are excellent; the company operates a superannuation scheme, and financial assistance towards removal and housing will be considered in appropriate cases.

Write, in confidence, to the Personnel Officer, giving full details. 1497

LONDON TRANSFORMER DRAWING OFFICE

'ENGLISH ELECTRIC'

GOOD TRANSFORMER DRAUGHTSMEN
as well as
MECHANICAL DRAUGHTSMEN

are required for work on the heavier range of transformer manufactured by the company (30 MVA - 350 MVA).

These are permanent staff appointments carrying excellent salaries and offering opportunity for advancement within the Group to men who wish to progress.

This new office is pleasantly appointed in a modern office block 5 minutes from Victoria Station.

There are also attractive openings for JUNIOR DRAUGHTSMEN in this office.

We would also like to hear from Senior and Junior Draughtsmen interested in similar work at our STAFFORD works.

Please write giving full details to Central Personnel Services, 336/7, Strand, London, W.C.2, quoting Ref. ER.1299C. 1521

NORTH WESTERN ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEERS, SUB-AREA ENGINEER'S DEPT., MANCHESTER

APPLICANTS should possess the H.N.C. in Electrical Engineering or an equivalent qualification, and should have had a basic works training of not less than two years. Consideration will also be given to applicants in possession of the O.N.C. who are progressing towards obtaining their H.N.C. The successful candidates will be required to work in Manchester and surrounding districts, and will be given the opportunity to gain experience in various sections of the Engineering Department.

Salary scale £540 × £15 to £585 p.a., Grade M.20. N.J.B. conditions.

Applications, naming three referees, to Sub-Area Secretary, No. 1 Sub-Area, North Western Electricity Board, Town Hall, Manchester, 2, P.O. Box 493, by 16th December, 1957. 1517

LANCASHIRE DYNAMO & CRYPTO LTD.

Trafford Park, Manchester, 17

require the undermentioned additional staff :—

TECHNICAL ASSISTANTS for Service Dept. Applicants should have good technical background (preferably H.N.C. standard), be conversant with electrical rotating machinery, and able to handle correspondence.

5-day week. Pension scheme.

Applications will be treated with the strictest confidence and should be addressed to the Personnel Manager. 1509

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

SERVICE CENTRE SUPERVISOR required in the Northwich District. Salary within range £855/£930 per annum (N.J.C. Grade 5).

Applicants should have had a sound training on the commercial side of an electricity supply undertaking or in the electrical retail trade, and must have a wide knowledge of modern electrical appliances for commercial and domestic use.

The successful candidate will be responsible for the satisfactory working of the service centre and the supervision and control of staff. The duties of the post will include cash and credit sales, hire purchase transactions, window dressing and display, the receipt of cash and dealing with consumers' enquiries.

Appointment subject to medical examination. Pension scheme.

Application forms obtainable from the Manager, No. 2 Sub-Area, Sandiway House, near Northwich, Cheshire. Closing date 16th December, 1957. 1536

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

Assistant Shift Charge Engineer

APPLICATIONS are invited from suitably qualified engineers for the above post. Applicants should have a sound practical and technical training, with experience of large turbo-alternators and switching operations on 33 and 132-kV system associated with a generating station.

Salary N.J.B. Scale, Class F, Grade 9 (£790 × £15 to £830 per annum).

Successful applicant to commence his duties on Tuesday, 1st April, 1958.

Application forms, obtainable from the undersigned, should be submitted by 23rd December, 1957.

R. B. ANDERSON, M.I.E.E.,
Area Manager.

7, Dudhope Crescent Road,
Dundee.
26th November, 1957. 1518

FOREMAN ELECTRICIAN

required by RICHARD COSTAIN LTD. for work on their Maldive Contract, 600 miles south-west of Ceylon.

Applicant should have had practical experience with diesel generators up to 150 kVA rating, and overhead distribution systems. Duties will include the installation of heavy plant, accommodation and workshop systems. He will also be responsible for the maintenance and repair of the systems. Tour of approximately 24 months and possibility of U.K. leave after 12 months. Good salary, free messing and single accommodation provided. Kit allowance £60. Generous leave.

Apply stating age and full details of experience to the Personnel Department (Overseas Recruitment), 111 Westminster Bridge Road, London, S.E.1. 1545

VACANCIES IN TRANSFORMER DESIGN OFFICE

THIS company is desirous of adding to its existing personnel in the Transformer Design Office, and requires persons with a good design background on transformer work from the smaller outputs up to 1,000 kVA at 66 kV, both oil-immersed, air-cooled and special insulated types.

Applications stating details of past experience, etc., to—

THE NELSON ENGINEERING CO. LTD.
Netherfield Road, Nelson, Lancashire
1430

ELECTRICAL ENGINEER (JUNIOR)

required in Consulting Engineers' Office for design and supervision of installations in the factories, shipyards, hospitals, etc. H.N.C. required.

Salary according to qualifications and experience. 5-day week; superannuation.

Apply in writing to R. W. Gregory & Partners, 54, Bloomsbury Street, London, W.C.1. 1569

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

CONSUMERS' ENGINEER required in the Wrexham District. Salary within range £835/£880 per annum (N.J.B. F/8).

Applicants should have had an engineering training, and experience in dealing with installation work, consumers' enquiries and general commercial duties. A knowledge of the work of rural development and organisation of agricultural shows and exhibitions would be an advantage.

Appointment subject to medical examination. Pension scheme.

Application forms obtainable from the Manager, No. 4 Sub-Area, Electricity House, Rhostyllen, near Wrexham. Closing date 18th December, 1957. 1563

ASSISTANT ENGINEER (ELECTRICAL)

APPLICANTS must be Graduate Members of the Institution of Electrical Engineers, and have passed the Institution examination (lately the Associate Membership examination) or hold exempting qualifications. Commencing salary on a scale rising to £1,065 per annum (inclusive of London weighting) according to age and experience.

The above post offers opportunities to cover the whole field of hospital electrical engineering, but previous experience in this work is not necessary.

Applications giving age, present salary, qualifications and experience (with dates), together with the names of two referees, should be sent to the Secretary, North East Metropolitan Regional Hospital Board, 11a, Portland Place, London, W.1, within 14 days. 1564

Applications are invited by
FREDERICK S. SNOW AND PARTNERS
for an
ELECTRICAL ENGINEER

to be posted at the New Gatwick Airport. Applicants should have a sound training and experience for the duties of installation and maintenance engineer. The scope of work includes H.V. and M.V. distribution, power standby plant, and a wide range of electrical installations within buildings.

Applicants should preferably hold the Higher National Certificate in Electrical Engineering or equivalent qualifications and experience.

Candidates should send, in confidence, full particulars of education, training and experience to :—

Frederick S. Snow and Partners,
Box No. 116, London, W.C.2. 1565

A.C. MOTOR DESIGNER

required by
MAVOR & COULSON LTD.

with experience on the design of totally enclosed machines up to 3,300 volts. Applicants must be conversant with automatic control gear; knowledge of flameproof enclosures an advantage but not essential.

Sports and social activities; pension scheme and good working conditions.

State age, qualifications and experience by letter to the

Personnel Manager
MAVOR & COULSON LTD.
47, Redan Street, Glasgow, S.E.
1532

SCOTTISH CABLES LIMITED

Oil-filled Cables

CABLE TECHNICIAN

required having experience of design, manufacture and installation of oil-filled cables.

Apply in confidence stating age, training and experience to the

Managing Director
SCOTTISH CABLES LIMITED
Renfrew
1533

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for the post of THIRD ASSISTANT ENGINEER (Distribution) in the Chief Engineer's Department at Board Headquarters.

Candidates should have a sound general and technical education, preferably leading to Corporate Membership of the Institution of Electrical Engineers. Experience of the operation and maintenance of large urban and rural distribution systems up to and including 33 kV is essential.

Salary N.J.B. Schedule B, Class AX/DX, Grade 5 (£1,055/£1,285) or Grade 6 (£895/£1,110) per annum, with placing according to qualifications and experience. The position is superannuable.

Apply quoting Reference No. E52/57 on Form AE6 available from the Secretary, P.O. Box 173, 351 Sauchiehall Street, Glasgow, C.2, not later than Friday, 20th December, 1957. 1577

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

A FOURTH ASSISTANT ENGINEER is required in the Tele-Communications Section of the Technical Department. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Grade 8, commencing in range £710 to £835, ultimately rising to £935 per annum.

Preference will be given to candidates who have had experience with tele-communications equipment, and the possession of a qualification equivalent to the Higher National Certificate in Electrical Engineering would be an advantage.

Apply quoting Vacancy No. 695MD on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 31st December, 1957. 1560

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

APPLICATIONS invited for the post of SECOND ASSISTANT ENGINEER in the Electrical and Mechanical Engineer's Department of the Board's Head Office, Edinburgh. Applicants should have a sound technical education and be capable of dealing with matters of technical design and investigation in generating station planning and operation.

Salary commencing at a point within the range £1,145-£1,340 (N.J.B. Schedule B, Class AX/CX, Grade 4) depending on experience and qualifications. Superannuation scheme.

Application form obtainable from The Secretary, 16, Rothesay Terrace, Edinburgh, 3, should be returned within 21 days from the date of this advertisement. 1578

CENTRAL ELECTRICITY AUTHORITY

Midlands Division

SHIFT CHARGE ENGINEER is required at Walsall Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule A of the Agreement, Grade H7, £995-£1,055 per annum, plus 10% for shift duties.

Applicants should have received a sound technical training and practical experience in the operation and maintenance of steam generating plant and main switchgear. Appropriate technical qualifications will be an advantage.

Apply, quoting vacancy number 697MD on form AE6, available from the Establishments Officer, 53, Wake Green Road, Moseley, Birmingham, 13, by 19th December, 1957. 1559

COUNTY OF LANARK

TECHNICAL ASSISTANT wanted for Council's Lighting Department at Hamilton. Salary A. & P. Grades II and III (£625/£715) with placing according to qualifications and experience. Must have sound technical training and practical experience in electrical engineering; neat draughtsman, capable of preparing all types of working drawings and plans required in connection with work of department. Knowledge of street lighting desirable. Superannuation. Medical examination. No canvassing.

Form of application from County Clerk, P.O. Box 1, Glasgow, and must be returned to him by 20th December, 1957. 1535

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

ASSISTANT CONSUMERS' ENGINEER required in the Liverpool North District. Salary within range £635/£680 per annum (N.J.B. Class H, Grade 14).

Duties include estimating for contracting work and advising consumers on electricity supply matters. Technical qualifications desirable.

Appointment subject to medical examination. Pension scheme.

Standard application forms should be forwarded to the Manager, No. 1 Sub-Area, 24, Hatton Garden, Liverpool, 3, not later than 18th December, 1957.

Applications received in response to the previous advertisement for this vacancy dated 16th October, 1957, are still under consideration. 1562

MUIRHEAD & CO. LTD.
Beckenham, Kent

ELECTRONIC TEST ENGINEERS required for modification, test and calibration of the company's range of instruments covering the lower frequency range 0.1 c/s to 100 Kc/s. Some technical qualifications an advantage but real technical experience with high-grade equipment is the first requirement. Each engineer is responsible for his individual job, from the initial fault finding to the finished job ready for inspection. These are staff appointments with ideal working conditions. Salaries commensurate with qualifications and experience. A pension scheme is in operation and the company has its own sports ground. Please write giving full particulars to the Personnel Manager. 1522

SOUTH WALES ELECTRICITY BOARD

SENIOR ASSISTANT (Administration) required in the Secretary's Office of the Board, St. Mellons, Cardiff.

Applicants should have general administrative experience, preferably of organisation and public relations. Knowledge of the electricity supply industry and possession of a secretarial or legal qualification would be an advantage.

Salary Grades 4/5 (£760/£930) of the N.J.C. (Administrative and Clerical Grades).

Applications stating age, present position and salary, qualifications, experience and three referees should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 23rd December, 1957. 1575

Applications are invited by
THE BENJAMIN ELECTRIC LTD.
for a
DESIGNER OF INDUSTRIAL LIGHTING EQUIPMENT.

Knowledge of fabricating techniques, finishes, lamps and control gear desirable, but initiative and ideas equally important.

Apply Chief Technical Engineer, Brantwood Works, Tottenham, London, N.17.

177

SOUTH WALES ELECTRICITY BOARD

COMMERCIAL ASSISTANT required, District 468 (Bargoed) in the Eastern Sub-Area of the Board.

Salary Class E, Grade 10 (£685/£730) of the N.J.B. Agreement.

Applications stating age, present position and salary, qualifications, experience and three referees should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 16th December, 1957. 1573

ESTIMATING ENGINEERS SENIOR AND JUNIOR DRAUGHTSMEN
required by

Whipp & Bourne Ltd., Castleton, Rochdale, manufacturers of A.C. and D.C. circuit breakers and switchboards. Previous experience in this field preferable. Posts are pensionable.

Apply to the Managing Director stating present salary. 1481

ELECTRICAL ENGINEER

required conversant with the general correspondence and technical detailing in connection with all quotations, etc., related to transformer and motor production. This is a senior appointment and a man with good experience in this range of activity is required.

The position offers full opportunity for advancement, and a man with ambition to progress is called for.

Applications stating full details of past experience to—

THE NELSON ENGINEERING CO. LTD.
Netherfield Road, Nelson, Lancashire
1431

COVENTRY CORPORATION

ASSISTANT ELECTRICAL ENGINEER required. Grade, if qualified, £750 × £1,030 per annum; £26 local award paid in addition to salaries up to £795 in approved circumstances. Experience, design and supervision lighting and power installations in schools or other large buildings essential. Grad. M.I.E.E. preferred. Housing accommodation may be available. Removal expenses loan available.

Application forms from City Engineer, Council House, Coventry, returnable by the 19th December, 1957. 1548

SURREY EDUCATION COMMITTEE

Wimbledon Technical College, Gladstone Road, London, S.W.19

APPLICATIONS are invited for part-time teaching work, day and/or evening, during the present session, in Mathematics and Advanced Electrical Engineering subjects.

Application forms may be obtained from the Registrar, and should be returned to the Principal as soon as possible.

T. S. HARKER, B.A., B.Sc.,
Principal.
1519

SOUTH WALES ELECTRICITY BOARD

ASSISTANT ENGINEER (Substations) required, District 222 (Neath) in the West Central Sub-Area of the Board.

Salary Class E, Grade 7 (£835/£880) of the N.J.B. Agreement.

Applications stating age, present position and salary, qualifications, experience and three referees should be addressed to the Secretary (Establishments Section), St. Mellons, Cardiff, so as to reach him not later than Monday, 16th December, 1957. 1574

BARROW IRONWORKS LIMITED
Barrow-in-Furness

ASSISTANT ELECTRICAL ENGINEER required with sound technical training and practical experience on maintenance, installation, generation and control equipments up to 6,600 v. A.C. On heavy plant as associated with blast furnaces.

The post is superannuable.

Reply, giving full details of education, training, etc., to Managing Director, Barrow Ironworks Limited, Barrow-in-Furness. 1567

A. ROBINSON & Company Ltd., Knowsley Road, Bootle, 20, Lancs, require an electrician as chargehand in the maintenance of light engineering factory electrical plant including remote indicator type of instrument work. Applicants must have practical experience in connection with the above. Only applications stating in writing full details of experience and qualifications will be considered. 1498

A TECHNICAL sales representative for Yeovil and West Country. Generous salary/commission/expenses. Must own car. Pension scheme, 5½-day week. Only applicants with experience, initiative and dynamic personality will be considered. Full details to—Man. Dir., British Central Electrical Co. Ltd., 6, Rosebery Avenue, London, E.C.1. 1499

APPLICATIONS are invited for position of technical assistant contract engineer with large electric cable contracting company. Applicants should have minimum qualification of O.N.C. in Electrical Engineering. Duties comprise compiling detailed schemes for electrical transmission and distribution. Ample scope for promotion. Pension fund and other privileges.—Box 1523.

***Situations Vacant** (continued)*

AN electrical engineer is required for a junior post concerned with the design and development of electro-mechanical equipment for railway signalling and traffic control systems. Qualifications: Graduate or H.N.C. in Electrical Engineering or C. and G. Telecommunications Certificates. Those studying for the foregoing qualifications will be considered. Day release may be granted in special cases. 5-day week and pension scheme. Apply in writing, giving age, qualifications and previous experience, to the Personnel Superintendent, Westinghouse Brake & Signal Co. Ltd., Chippenham, Wilts, quoting ref. EED/1/ER. 1483

AN electronic engineer required by well-known instrument company in London. B.Sc. in Electrical Engineering essential. Age 22-28; to work on transistor circuit development for very interesting industrial applications. Salary £750/£850.—Box 1482.

ASSISTANT electrical engineer required by steel tube manufacturers in Birmingham, to be responsible for all electrical maintenance and repairs, including a large number of overhead cranes and other lifting appliances, total load 7,000 kVA. Applicants must be between the age of 24 and 30, have a university degree or equivalent, and have served a recognised apprenticeship or training for at least 3 years in electrical engineering. Contributory pension scheme. Apply, stating age, qualifications, experience and salary required to—Personnel Manager, Tubes Limited, Aston, Birmingham, 6. 1579

ASSISTANT mechanical contract design engineers required by firm of consultants in their London office. Applicants must have had a good mechanical training and experience, preferably with steam power plants and associated equipment. Duties will consist of the preparation of specifications, estimates and contract documents, and also to assist in the execution of large engineering contracts from the design stage through to the completion of the work at site. Electrical experience and knowledge of nuclear power station practice will be an advantage. The salary offered will be according to experience and ability, and the post is pensionable. Applicants must state fully their technical qualifications and give full particulars of training and experience, which must be addressed to the Personnel Officer, Ewbank & Partners Ltd., 10/11, Grosvenor Place, London, S.W.1. 1580

BELLING & LEE Limited, manufacturers of radio and electronic components, have a vacancy for a personal assistant to the sales director, aged 27/33, with a public school education and holding an engineering degree or similar qualification. Should have completed a student apprenticeship course and have some experience of office or works management. Applicants possessing personality and anxious for advancement, for which there will be ample opportunity, should write in confidence giving full details of their qualifications and career to date, to the Secretary, 540, Great Cambridge Road, Enfield, Middlesex. 1524

BRITISH ENGINE BOILER & ELECTRICAL INSURANCE Co. Ltd., 24, Fennel Street, Manchester, 4. Electrical surveyors required for various districts in Great Britain. Permanent positions carrying progressive salary scale £735 to £1,060 and non-contributory pension. Candidates, age 26 to 32, preferably with H.N.C. in Electrical Engineering or Grad. I.E.E., and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply in own handwriting stating age, qualifications and experience. 1526

CABLE jointer wanted. Used to H.T. and L.T. jointing. Also must have experience of general installation.—Box 1357.

CIRCUIT design draughtsmen required by company manufacturing industrial control equipment. Good salaries paid to "first-class" men. Canteen facilities, pension scheme. Housing assistance considered in approved cases. Write giving age, experience, etc., to—Personnel Officer, Dewhurst & Partner Ltd., Inverness Works, Inverness Road, Hounslow, Middx. 273

DESIGNER draughtsman, leading firm of contractors London, has a senior appointment of wide scope and interest available to a first-class engineer able to design (and supervise site work) high-class electrical installations of all types. Good junior also required. Excellent prospects and salary. Write, experience, age and salary envisaged.—Box 1203.

CROMPTON PARKINSON require a keen and energetic sales engineer for the Glasgow branch of their stud welding organisation. Technical and commercial experience in metal-working industries is essential. Specialised training will be given to successful candidate for post which offers good prospects to man willing to make vigorous and persistent effort. Applicants should reply in their own handwriting giving full details of education and experience to Reference US, Crompton Parkinson Limited, Stud Welding Organisation, 1/3, Brixton Road, London, S.W.9. Replies will be treated in confidence. 1539

DESIGN engineer required for transformers up to 25 kVA. Salary commensurate with experience. Good opportunity for person seeking improvement. Apply to—G. B. Electrical Services Ltd., 1, Goodmayes Road, Goodmayes, Ilford, Essex. 1493

DESIGNER-draughtsman required, experienced in L.T. switchgear layout and fabrication of sheet steel control panels. Knowledge of power and control circuits required. Permanent position, pension scheme. State salary required. Apply Chief Engineer, Astral Switchgear Ltd., Alma Rd., Enfield, Middlesex. 1540

DEVELOPMENT engineer for design of small electrical switches, components and other electro-mechanical devices. Please write advising experience to—D. C. Phipps, Director, Crater Products Ltd., St. Johns, Woking. 1541

DEVELOPMENT engineer for research department developing electronic and light electro-mechanical control equipment. Applicants should possess H.N.C. or equivalent qualifications and have at least 3 years' experience in similar work. Salary according to experience.—Londex Ltd., 207, Anerley Road, London, S.E.20 (Phone: SYD. 3111, Ext. 17). 1581

DEWHURST & PARTNER Ltd. require technical estimator for preparing tenders in their estimating engineering department. Applicant must have good electrical engineering background and have basic knowledge of motor control equipment and its applications. The position is a senior one, and housing assistance will be given to successful applicant if necessary. Canteen facilities, pension scheme. Write giving age, experience, etc., to — Personnel Officer, Dewhurst & Partner Ltd., Inverness Works, Inverness Road, Hounslow, Middlesex. 274

ELECTRICAL contractor (London) has vacancy for estimator used to large contracts, capable of handling them from enquiry to completion. Exceptional opportunity for experienced man able to accept responsibility. Applications will be treated confidentially. State age, salary, with concise particulars of experience.—Box 1584.

ELECTRICAL contractors require an estimating engineer with sound knowledge of industrial installations. Progressive position for suitable applicant. Reply in strict confidence giving full details of age, experience and salary required to—Electric House (Denton) Ltd., Law Street, Denton, Manchester. 9202

ELECTRICAL contractors require staff foreman centred on Luton office. Must be capable of handling all types of electrical contracts and able to drive. Apply in writing in first instance to — David Thomson Electrical Engineers Ltd., 26, Albion Rd., Luton. 1582

ELECTRICAL sales engineer having experience in motor control gear required for London office area. Vacancy offers good salary and is pensionable. Write stating age, experience, etc., to—London Manager, Igranic Electric Co. Ltd., Victoria Station House, Victoria Street, London, S.W.1. 1459

ENGINEER required for high-voltage engineering work, age 22-27, with degree or H.N.C. and works training (electrical power equipment). Apply giving details of training and experience to — The Assistant Secretary, The Micanite & Insulators Co. Ltd., Empire Works, Blackhorse Lane, Walthamstow, London, E.17. 1500

ESTIMATING and supervising electrical engineer required for established contractors' London office. Applicants must be capable of handling work for industrial and commercial installations through from design stage to completion. Write stating experience, salary, etc., to—Box 1542.

ESTIMATING engineer required for preparing tenders for A.C. and D.C. switchgear, open and enclosed pattern switchboards. Canteen facilities, pension scheme. Apply to—Whipp & Bourne Ltd., Switchgear Works, Castleton, Rochdale. 1374

ELECTRO-mechanical draughtsmen required for production drawing office of company engaged in the manufacture of control gear equipment. Good salaries paid to "first-class" men. Canteen facilities, pension scheme. Housing assistance considered in approved cases. Write giving age, experience, etc., to—Personnel Officer, Dewhurst & Partner Ltd., Inverness Works. Inverness Road, Hounslow, Middx. 275

HIGH-voltage plumber-jointers and mates, experienced in jointing all classes of cables up to and including 11 kV, required for contract work in South-East England.—Box 1595.

JUNIOR commercial/technical assistant required in lighting dept. of well-known firm of fittings mfrs. in N. London. Duties will include sales correspondence, preparation of quotations and allied matters. Salary in accordance with age, experience and ability. Please apply in writing to General Manager, Courtney, Pope (Electrical) Ltd., Amhurst Park Works, Tottenham, London, N.15. 1527

JUNIOR electrical engineer/draughtsman. Age 22/25, H.N.C. or O.N.C., experienced in estimating and contract work for mechanical handling plant. Pension fund. Sports and canteen facilities. Particulars of experience, qualifications and salary to—W. J. Jenkins & Co. Ltd., Retford, Notts. 1501

JUNIOR estimator wanted by prominent electrical contractors in London. Must have served apprenticeship. Progressive position for ambitious man. Write in confidence, experience, age and salary required.—Box 1583.

LAMP factories in London have vacancies for technicians working with incandescent lamps and filaments. Applicants must be over 18 years of age with suitable experience or able to undertake further training. Apply, quoting ref. LED/WJM, to—Atlas Lighting Ltd., Angel Factory Colony Estate, Edmonton, London, N.18. 1550

LINESMEN (overhead power) (up to 30,000 volts) required to work from Rhos, Carmarthen. Experience in erection and maintenance of overhead mains essential. Present rate 4s. 5½d. per hour. Applications, stating age, qualifications and experience, to be sent to—W. E. Richardson, Sub-Area Manager, South Wales Electricity Board, South Beach Pavilion, Tenby, not later than 11th December, 1957. 1576

LONDON consulting engineers require electrical engineers for installation design for hospitals, commercial buildings, schools, etc. Write stating age, qualifications, experience and salary required to—Box 160.

M.T.E. CONTROL GEAR Limited require technical sales engineer manager for Greater London area. Must have sound technical knowledge in control gear and good existing business connections in the territory. Apply in writing to—Sales Director, Progress Road, Leigh-on-Sea, Essex. 1333

PRODUCTION engineer wanted for small electrical control gear works, Taunton, Somerset. State experience and salary required. —Box 353.

SALES assistant to director of firm of cable reel manufacturers; must be young, of smart appearance and preferably with experience of electric cable trade. All applications will be treated in confidence. Apply to—W. Hakesley, Heathfield & Co. Ltd., Trading Estate, Slough, Bucks. 1585

SALES engineer required by London manufacturer's agent to sell industrial electrical equipment to manufacturers and users. Opportunity for young man, preferably with H.N.C., who has keenness and initiative. Car provided. Write giving age, qualifications, etc., to—Box 1525.

SENIOR cable sales representative required for Manchester area. Applicants should possess a sound education and previous experience in the thermoplastic cable trade. All applications will be regarded as confidential. Full details to Managing Director, Permanoid Ltd., New Islington, Manchester, 4. 1543

SENIOR or junior draughtsman required for work on electrical power resistors and heaters for industrial applications. Previous experience on this class of work is desirable but not essential. Apply giving details of experience, technical qualifications, age and salary required to—The Electrical Department of The Expanded Metal Co. Ltd., Stranton Works, West Hartlepool. 1376

TELEPHONE engineer/mechanic, first-class, required, large firm engineers, 12 months' service overseas. Excellent opportunity. Write age, experience.—Box 1334.

SALES manager required to develop sales of electric lamps in home and export markets and especially within the Co-operative movement. Technical knowledge desirable, advertising and display experience useful, but the main requirements are experience of selling and of the organisation and supervision of representatives through correspondence and occasional visits. Knowledge of and sympathy with the Co-operative movement will be assets. The individual appointed will have his headquarters in Glasgow. Applicants should write details of age and experience and indicate salary range required to Secretary, British Luma Co-operative Electric Lamp Society Limited, 95, Morrison Street, Glasgow, C.5. Closing date 9th December, 1957. 1434

SOUTH WALES SWITCHGEAR Ltd., Blackwood, Mon., have vacancies for draughtsmen in the high-voltage switchgear contract and diagram sections of their drawing office. Applications, giving full particulars of experience, age and qualifications, to—The Personnel Manager. 1451

SUPERVISING engineer required by electrical engineering and contracting co. for service in East Africa. Applicant must be able to prepare schemes and quotations for all types of installations, and preference will be given to applicants with knowledge of o.h. lines. Salary according to qualifications and experience. Apply Marryats E. A. Ltd., 40, Hatton Garden, London, E.C.1. 1409

TESTER of automatic electric control equipment required. Interesting work with good prospects. O.N.C. standard preferred. Five-day week, pension scheme, canteen facilities. Please write giving full details of age, previous experience, qualifications, etc., to—Personnel Officer, Dewhurst & Partner Ltd., Inverness Road, Hounslow, Middlesex. 277

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SITUATIONS WANTED

CABLE jointer experienced in voltages up to 22 kV desires position abroad. Willing to go immediately. Excellent references.—Box 9211.

ELECTRICAL contractor's London manager (35) seeks change, managerial or executive post with reputable company. Available February or March. All enquiries answered. Please reply—Box 9215.

ELECTRICAL site engineer/agent, age 39, extensive installation experience, capable, energetic, seeking new situation, home near London.—Box 9208.

ARTICLES FOR SALE

CITY OF LEEDS

THE Transport Committee of the Leeds City Council has for disposal the following Sub-station Equipment for which offers are invited:

1 HEWITTIC Mercury Arc 1,500-kW Rectifier Set.
1 HEWITTIC Mercury Arc 1,500-kW Rectifier Set, minus bulbs.
2 HACKBRIDGE 1,500-kW Transformers, 6.6 kV, 3/12 phase.
1 BERTRAM THOMAS 10-panel, 600-volt, D.C. Switchboard with all accessories.
1 SWITCHGEAR & COWANS 5-truck Switchboard, 6.6 kV, 3 phase.
1 HEWITTIC Remote Control Cabinet.
1 HEWITTIC Mercury Arc Auxiliary Set for Remote Control, 2 phase, 200/250 volt, 80 amps. D.C.
1 NIFE Charging Set and Tripping Battery.

Further particulars along with conditions of sale and permission to inspect may be obtained upon application to the undersigned.

Offers in a sealed envelope endorsed "Transport—Offers for Substation Equipment," to be delivered to the Town Clerk, Room 57, Civic Hall, Leeds, 1, not later than 10 a.m. on Monday, 6th January, 1958, and must remain open for acceptance for six weeks thereafter.

A. B. FINDLAY,
M.I.Mech.E., M.I.P.E., M.Inst.T.
1, Swinegate, General Manager.
Leeds, 1.
December, 1957. 1586

WELDING PLANT

NEW OXFORD oil-cooled transformer-type Arc Welders for operation on 400/440/1/50; dual voltage output; current variable 20/300 amps.
£85 each ex works.
Immediate delivery.
Similar units available for lower current ratings and for special applications.

GORGE COHEN SONS & CO. LTD.
Wood Lane, London, W.12
(Tel. Shepherds Bush 2070) and
Stanningley, Nr. Leeds
(Tel. Pudsey 2241) 1528

LIGHT WEIGHT ALTERNATORS FOR PORTABLE GENERATING SETS

100 unused 4-kVA, 230-volt, single-phase, 100-cycle Alternators, 3,000 r.p.m., self-exciting with automatic voltage regulators. Immediate delivery with guarantee.

Alternators only - - Price £30.
Alternators with A.V.R.s Price £45.

GEORGE COHEN SONS & CO. LTD.
Wood Lane, London, W.12
(Tel. Shepherds Bush 2070) and
Stanningley, Nr. Leeds
(Tel. Pudsey 2241) 1530

GENERATORS

100 unused 30-kW, 225-volt D.C. Generators by MAWDSLEY, compound wound, 960 and 1,440 r.p.m., class 2, continuously rated, cowl ventilated.
First-class condition.
Immediate delivery covered by guarantee.

GEORGE COHEN SONS & CO. LTD.
Wood Lane, London, W.12
(Tel. Shepherds Bush 2070) and
Stanningley, Nr. Leeds
(Tel. Pudsey 2241) 1529

ALTERNATORS IN STOCK

All suitable for 3-phase, 50 cycles, 400-440 v.

500-kVA, 600-rev. CROM. PARK., 3-bearing.
329-kVA, 1,000-rev. ENG. ELEC., single-brng.
312½-kVA, 600-rev. CROM. PARK., 3-bearing.
170-kVA, 1,000-rev. BRUSH, 4-bearing.
150-kVA, 750-rev. CROM. PARK., 2-bearing.
120-kVA, 750-rev. ENG. ELEC., 3-bearing.
57½-kVA, 1,500-rev., 2-bearing.
22½-kVA, 1,500-rev. CROM. PARK.

THOMAS MITCHELL & SONS LIMITED
Bolton
1437

550-kW TURBO ALTERNATOR

by ENGLISH ELECTRIC. New in 1949. Initial steam pressure 170 lb. per s.i.g. Initial steam temperature 500° F. Exhaust pressure 15 lb. p.s.i.g. Output 687.5 kVA at .8 power factor, 400 volts, 3-phase, 50 cycles. Complete with alternator panel and breaker. Cabling between alternator and switchboard. Complete with full set arrangement drawings and operating instructions.
Apply for further information.

MADEN & McKEE LTD.
317, Prescot Road, Liverpool, 13
1503

ELECTRICAL EQUIPMENT FOR SALE

1500-h.p. B.T.H. Rolling Mill Motor, 3,300/3/50, 211 r.p.m.
1070-h.p. BRUCE PEEBLES ditto, 3,300/3/50, 495 r.p.m.
750-h.p. BROWN BOVERI ditto, 2,200/3/50, 146 r.p.m.
2500-h.p. Reduction Gear, ratio 5.3 to 1.

F. BURRILL & CO.
235a, Cathedral Road, Cardiff
(Tel. 26100) 1487

POLARISING EQUIPMENT FOR SALE

FOUR Processing Units, 200 m.a., 230 v., 3-phase. Each set comprises VARIAC control unit with fuses and metering, an oil 5.5-kVA H.T. transformer, 230 to 20,000 volts, and a Selenium rectifier assembly.

The Secretary
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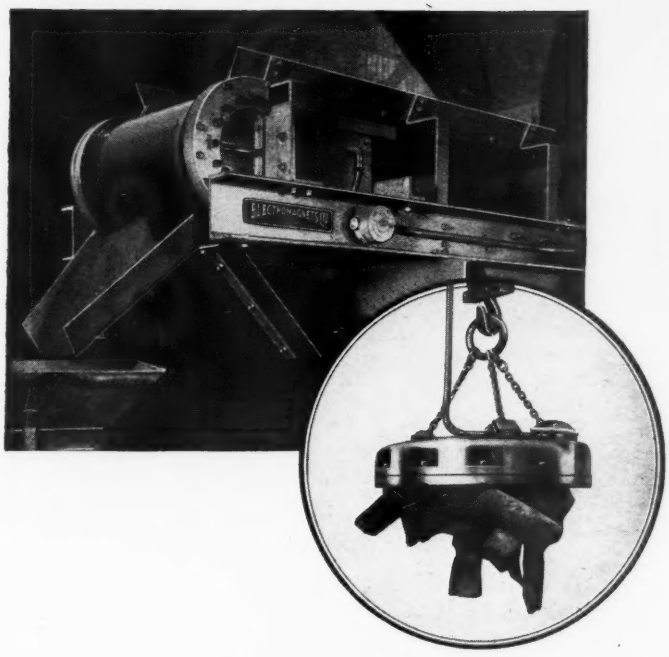

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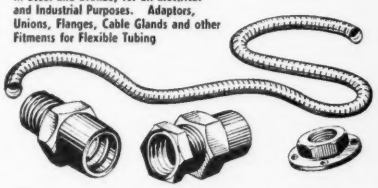

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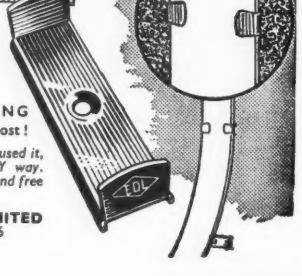

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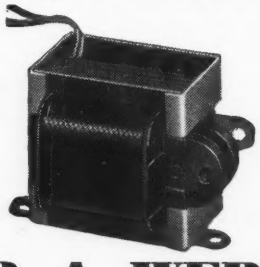

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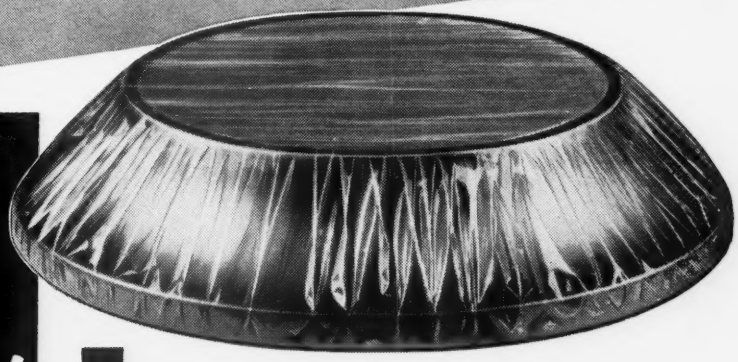

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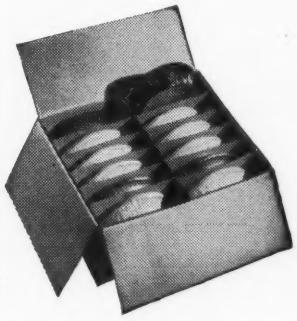

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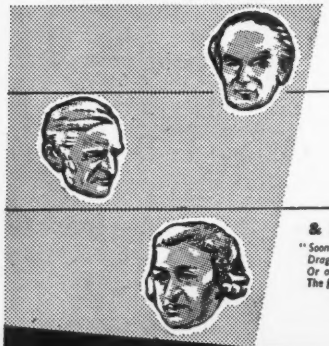

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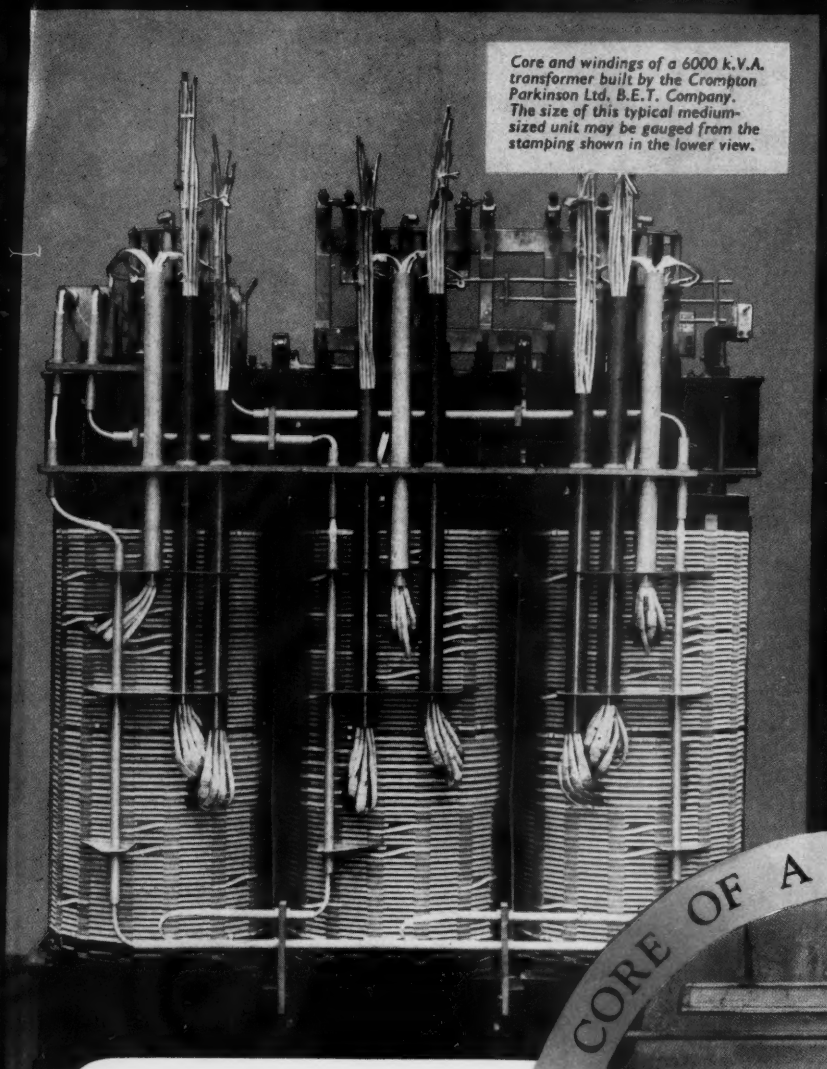
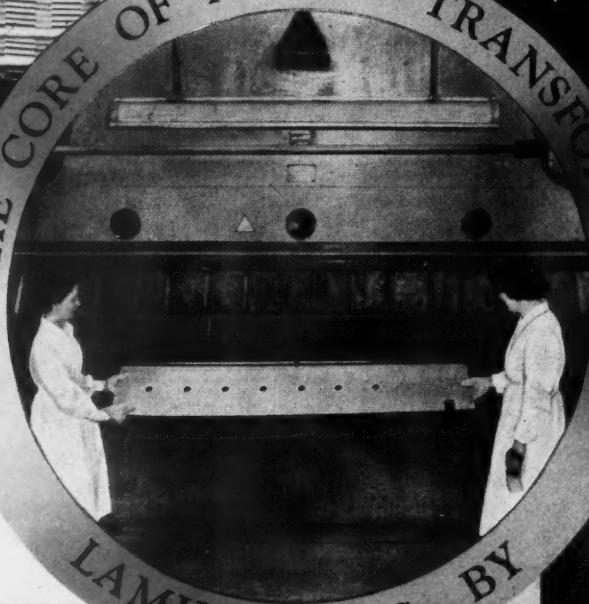


Core and windings of a 6000 k.V.A. transformer built by the Crompton Parkinson Ltd. B.E.T. Company. The size of this typical medium-sized unit may be gauged from the stamping shown in the lower view.

THE CORE OF A FINE TRANSFORMER



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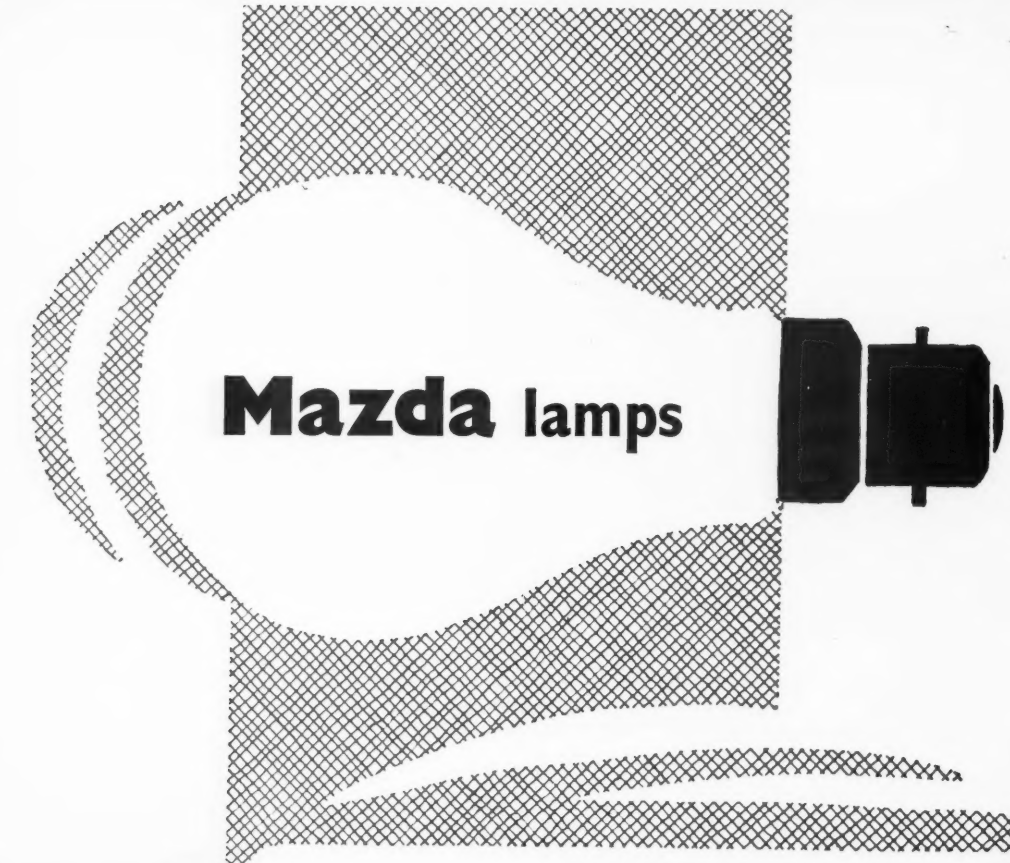

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